PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-021622

(43)Date of publication of application : 23.01.2002

(51)Int.Cl. F02D 41/22
F02D 41/04
F02D 41/08
F02D 41/14
F02D 45/00

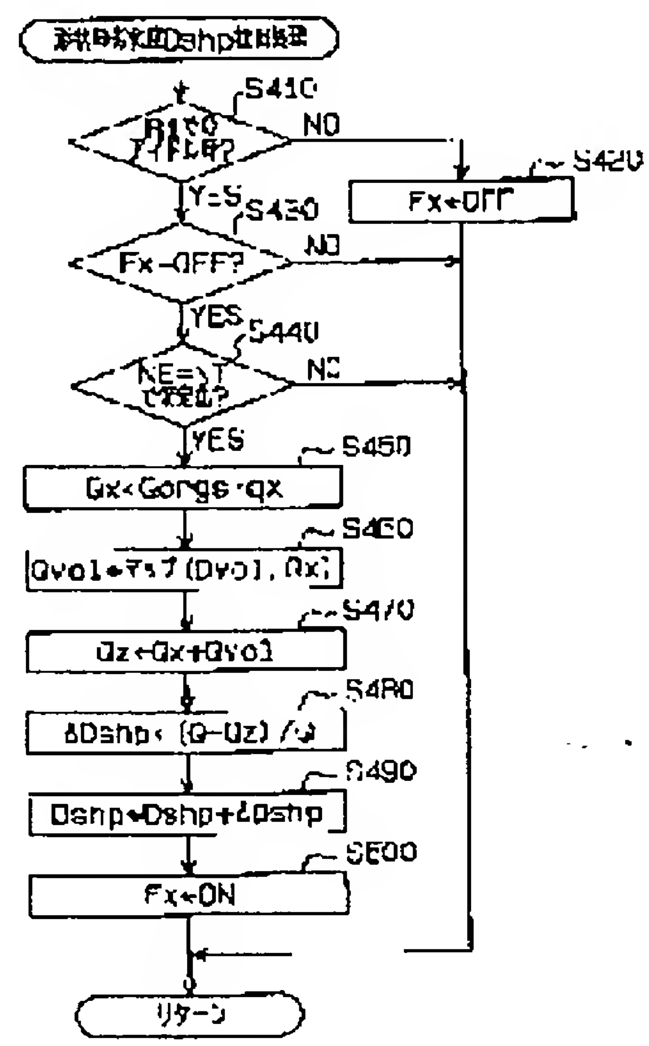
(21)Application number : 2000-211418

(22)Date of filing : 12.07.2000

(71)Applicant : TOYOTA MOTOR CORP

(72)Inventor : OTANI GENKI
TSUCHIYA TOMIHISA

(54) FUEL INJECTION VALVE DETERIORATION DETECTION DEVICE AND INTERNAL COMBUSTION ENGINE CONTROL DEVICE



(57)Abstract:

PROBLEM TO BE SOLVED: To realize a detection of deterioration degree other than an injection amount such as an injection shape in a fuel injection valve and to suitably control an engine by reflecting it to a control of an internal combustion engine.

SOLUTION: In order to determine a shape-like deterioration in a fuel injection valve, a presumed fuel injection operation amount Qx at a laminated combustion is corrected by a quantitative injection correction amount Qvol determined from a quantitative deterioration degree Dvol in the fuel injection valve and a presumed fuel injection operation amount Qz after correction is determined (S470). A lack degree 'Q-Qz' which the presumed fuel injection operation amount after correction Qz has against an actual fuel injection operation amount Q is determined and a shape-like deterioration degree variation amount ΔDshp is determined by dividing it by the actual fuel injection operation amount Q. A shape-like deterioration degree Dshp, i.e., a deterioration degree other than a fuel injection amount from this shape-like deterioration degree variation amount ΔDshp (S490). Thus, the shape-like deterioration degree Dshp only indicating a deterioration degree other than the fuel injection amount can be determined and a preferable engine control becomes possible.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] It is fuel injection valve degradation detection equipment which detects degradation degrees other than the injection quantity in the fuel injection valve used in order to form gaseous mixture with an internal combustion engine. The assumption fuel-injection control input in the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability The lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve amends. Fuel injection valve degradation detection equipment characterized by having a degradation degree detection means to detect degradation degrees other than the fuel oil consumption in a fuel injection valve, based on the lack degree b which the assumption fuel-injection control input after this amendment has to a real fuel-injection control input.
[Claim 2] It is fuel injection valve degradation detection equipment which is the cylinder-injection-of-fuel type internal combustion engine which chooses and performs stratification combustion and homogeneity combustion, and is characterized by said combustion gestalt A being stratification combustion in a configuration according to claim 1 while said internal combustion engine injects directly the fuel from a fuel injection valve into a combustion chamber.
[Claim 3] It is fuel injection valve degradation detection equipment with which degradation degrees other than fuel oil consumption [in / on a configuration according to claim 1 and / in said lack degree a / a fuel injection valve] are characterized by being a value reflecting the lack degree asked in the combustion gestalt B with which it is hard to influence flammability.
[Claim 4] It is fuel injection valve degradation detection equipment which is the cylinder-injection-of-fuel type internal combustion engine which chooses and performs stratification combustion and homogeneity combustion, and said combustion gestalt A is stratification combustion, and is characterized by said combustion gestalt B being homogeneity combustion in a configuration according to claim 3 while said internal combustion engine injects directly the fuel from a fuel injection valve into a combustion chamber.
[Claim 5] It is fuel injection valve degradation detection equipment characterized by being a value reflecting the lack degree which an assumption fuel-injection control input has to the real fuel-injection control input produced in order that said lack degree a may maintain an idle target rotational frequency in a configuration according to claim 3 or 4 at the time of the idle in the combustion gestalt B.
[Claim 6] It is fuel injection valve degradation detection equipment characterized by being [of claims 1-4] the value which reflected the lack degree which an assumption fuel-injection control input has to the real fuel-injection control input produced in order that said lack degree a may maintain a target air-fuel ratio in the configuration of a publication at the time of Air Fuel Ratio Control either.
[Claim 7] It is fuel injection valve degradation detection equipment characterized by being [of claims 1-4] a value reflecting the difference of the air-fuel ratio said lack degree a is assumed to be in the configuration of a publication based on an assumption fuel-injection control input, and the real air-fuel ratio based on an assumption fuel-injection control input either.
[Claim 8] It is fuel injection valve degradation detection equipment characterized by being a value reflecting the difference of the combustion pressure said lack degree a is assumed to be in a

configuration according to claim 3 or 4 based on the assumption fuel-injection control input in the combustion gestalt B, and the real combustion pressure based on an assumption fuel-injection control input.

[Claim 9] It is fuel injection valve degradation detection equipment characterized by being [of claims 1-8] the lack degree which the assumption fuel-injection control input after said amendment has to the real fuel-injection control input produced in order that said lack degree b may maintain an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A either.

[Claim 10] It is fuel injection valve degradation detection equipment characterized by being [of claims 1-8] a value reflecting the difference of the real air-fuel ratio at the time of said lack degree b maintaining an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A, and the air-fuel ratio assumed based on the assumption fuel-injection control input after said amendment either.

[Claim 11] It is fuel injection valve degradation detection equipment characterized by being [of claims 1-8] a value reflecting a difference with the air-fuel ratio said lack degree b is assumed to be in the configuration of a publication based on the real air-fuel ratio in the combustion gestalt A, and the assumption fuel-injection control input after said amendment either.

[Claim 12] It is fuel injection valve degradation detection equipment characterized by being [of claims 1-8] a value reflecting the difference of the real air-fuel ratio at the time of said lack degree b maintaining an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A, and the real air-fuel ratio at the time of carrying out fuel injection based on the assumption fuel-injection control input after said amendment either.

[Claim 13] It is fuel injection valve degradation detection equipment characterized by being [of claims 1-8] a value reflecting the difference of the real combustion pressure at the time of said lack degree b maintaining an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A, and the real combustion pressure at the time of carrying out fuel injection based on the assumption fuel-injection control input after said amendment either.

[Claim 14] It is fuel injection valve degradation detection equipment which detects degradation degrees other than the injection quantity in the fuel injection valve used in order to form gaseous mixture with an internal combustion engine. Among the lack degrees which it has to a real fuel-injection control input, the assumption fuel-injection control input in the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability Fuel injection valve degradation detection equipment characterized by having a degradation degree detection means to detect degradation degrees other than the fuel oil consumption in a fuel injection valve, based on the lack degree b of the part except the lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve.

[Claim 15] The fuel injection valve degradation detection equipment with which a fuel-injection control input adjusts and the fuel-injection control input which this adjusted is characterized by to obtain the lack degree which it has to the real fuel-injection control input for attaining the target rotational frequency at the time of the idle in the combustion gestalt A as said lack degree b so that it may become the air-fuel ratio which attained the target rotational frequency in early stages at the time of the idle in the combustion gestalt A in a configuration according to claim 14.

[Claim 16] It is fuel injection valve degradation detection equipment characterized by being a value reflecting the difference of an air-fuel ratio for said lack degree b to attain a target rotational frequency in a configuration according to claim 14 at the time of the idle in the combustion gestalt A, and the air-fuel ratio which attained the target rotational frequency in early stages.

[Claim 17] The internal combustion engine control unit characterized by having an amendment means to amend the engine controlled variable in the combustion gestalt A using degradation degrees other than the fuel oil consumption calculated with this fuel injection valve degradation detection equipment while having fuel injection valve degradation detection equipment according to claim 1 to 16.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the internal combustion engine control unit using the fuel injection valve degradation detection equipment which detects degradation degrees other than the injection quantity in the fuel injection valve used in order to form gaseous mixture with an internal combustion engine, and this fuel injection valve degradation detection equipment.
[0002]
[Description of the Prior Art] As a jump-spark-ignition type internal combustion engine which performs combustion by which fuel concentration was stabilized using very thin gaseous mixture, the cylinder-injection-of-fuel type internal combustion engine is known (JP,10-339196,A). This cylinder-injection-of-fuel jump-spark-ignition type internal combustion engine is injecting a direct fuel from a fuel injection valve in the compression stroke last stage at a combustion chamber at the time of stratification combustion, and is arranging the enriched mixture of fuel concentration in the shape of a layer around an ignition plug. And combustion stabilized in gaseous mixture thin as a whole is realized by lighting this stratification part and burning it.
[0003] In this kind of internal combustion engine, if a deposit accumulates at the head of a fuel injection valve, the injection condition from a fuel injection valve will change, and effect will be produced in flammability. Therefore, it is necessary to detect the degradation degree of this fuel injection valve, and to make it reflected in engine control.
[0004] With said conventional technique, the degradation degree of a fuel injection valve is detected based on the amount of gaps with the fuel-injection control input beforehand assumed to be a actual fuel-injection control input (specifically fuel injection duration) to a demand air-fuel ratio.
[0005]
[Problem(s) to be Solved by the Invention] However, with said conventional technique, the fuel oil consumption which runs short as a degradation degree in order to attain a demand air-fuel ratio is computed. For this reason, although the degradation degree of the injection quantity produced in the fuel injection valve appears in the degradation degree detected by doing in this way, about degradation degrees other than injection quantity which is called injection configuration, it is undetectable.
[0006] For this reason, in the internal combustion engine which performs combustion which tends to be influenced by degradation degrees other than the injection quantity, the problem said that it cannot make a degradation degree fully reflect in engine control is produced like the cylinder-injection-of-fuel type internal combustion engine.
[0007] This invention aims at offering the internal combustion engine control unit which enables suitable engine control by making it reflected in control of the internal combustion engine which performs combustion which tends to be influenced by degradation degrees other than the injection quantity while it offers the fuel injection valve degradation detection equipment which enables detection of degradation degrees other than the injection quantity.
[0008]
[Means for Solving the Problem] Hereafter, the means and its operation effectiveness for attaining the above-mentioned object are indicated. It is fuel injection valve degradation detection equipment which detects degradation degrees other than the injection quantity in the fuel injection valve used in

order that fuel injection valve degradation detection equipment according to claim 1 may form gaseous mixture with an internal combustion engine. The assumption fuel-injection control input in the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability The lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve amends. It is characterized by having a degradation degree detection means to detect degradation degrees other than the fuel oil consumption in a fuel injection valve, based on the lack degree b which the assumption fuel-injection control input after this amendment has to a real fuel-injection control input.

[0009] It can ask for the lack degree of the assumption fuel-injection control input which the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption are reflecting in the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability. However, in having detected the lack degree which the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption compounded in this way, the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption are inseparable.

[0010] However, the lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve is detectable. Therefore, the lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve amends the assumption fuel-injection control input in the combustion gestalt A. And degradation degrees other than fuel oil consumption are detectable by asking for the lack degree b which the assumption fuel-injection control input after this amendment has to a real fuel-injection control input.

[0011] Fuel injection valve degradation detection equipment according to claim 2 is a cylinder-injection-of-fuel type internal combustion engine with which stratification combustion and homogeneity combustion are chosen and said internal combustion engine performs it in a configuration according to claim 1 while injecting directly the fuel from a fuel injection valve into a combustion chamber, and it is characterized by said combustion gestalt A being stratification combustion.

[0012] In stratification combustion, since degradation degrees other than fuel oil consumption, such as an injection configuration, influence flammability greatly with the degradation degree of the fuel oil consumption in a fuel injection valve, the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption are reflected in a real fuel-injection control input at the time of stratification combustion. Degradation degrees other than fuel oil consumption are detectable by asking for the lack degree b which the assumption fuel-injection control input after said amendment has from a real fuel-injection control input by this.

[0013] Fuel injection valve degradation detection equipment according to claim 3 is characterized by said lack degree a being a value reflecting the lack degree asked for degradation degrees other than the fuel oil consumption in a fuel injection valve in the combustion gestalt B which cannot influence flammability easily in a configuration according to claim 1.

[0014] About the lack degree a, it can ask as a value in which the lack degree for which it asked in the above-mentioned combustion gestalt B was made to reflect. Since degradation degrees other than the fuel oil consumption in a fuel injection valve cannot influence flammability easily, the above-mentioned combustion gestalt B can ask for the lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve.

[0015] Therefore, it can ask for the lack degree b which the assumption fuel-injection control input after the lack degree a amends has from a real fuel-injection control input, and degradation degrees other than fuel oil consumption can be detected.

[0016] Fuel injection valve degradation detection equipment according to claim 4 is a cylinder-injection-of-fuel type internal combustion engine with which stratification combustion and homogeneity combustion are chosen and said internal combustion engine performs it in a configuration according to claim 3 while injecting directly the fuel from a fuel injection valve into a combustion chamber, said combustion gestalt A is stratification combustion, and said combustion gestalt B is characterized by being homogeneity combustion.

[0017] In stratification combustion, since degradation degrees other than fuel oil consumption influence flammability greatly with the degradation degree of the fuel oil consumption in a fuel injection valve, the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption are reflected in the real fuel-injection control input at the time of stratification combustion.
[0018] And in homogeneity combustion, since degradation degrees other than fuel oil consumption hardly influence flammability, it can ask for the lack degree a of an assumption fuel-injection control input to a real fuel-injection control input at the time of homogeneity combustion.
[0019] Therefore, degradation degrees other than fuel oil consumption are detectable by asking for the lack degree b which the assumption fuel-injection control input amended based on the lack degree a for which it asked at the time of homogeneity combustion has from the real fuel-injection control input at the time of stratification combustion.
[0020] Fuel injection valve degradation detection equipment according to claim 5 is characterized by said lack degree a being the value which reflected the lack degree which an assumption fuel-injection control input has to the real fuel-injection control input produced in order to maintain an idle target rotational frequency at the time of the idle in the combustion gestalt B in a configuration according to claim 3 or 4.
[0021] The lack degree a can ask for the lack degree which an assumption fuel-injection control input has to the real fuel-injection control input produced in order to maintain an idle target rotational frequency at the time of the idle in the combustion gestalt B, and, more specifically, can ask for it as a value reflecting this lack degree.
[0022] With the combustion gestalt B with which degradation degrees other than fuel oil consumption cannot influence flammability easily, the lack degree produced in the assumption fuel-injection control input to the real fuel-injection control input required in order to maintain an idle target rotational frequency can be called thing only showing the degradation degree of the fuel oil consumption in a fuel injection valve.
[0023] Thus, an assumption fuel-injection control input can be amended based on the lack degree a in which the lack degree easily obtained by operation at the time of the idle in the combustion gestalt B was made to reflect. And degradation degrees other than fuel oil consumption are easily detectable by asking for the lack degree b which the assumption fuel-injection control input after this amendment has to the real fuel-injection control input in the combustion gestalt A.
[0024] Fuel injection valve degradation detection equipment according to claim 6 is characterized by being [of claims 1-4] the value which reflected the lack degree which an assumption fuel-injection control input has to the real fuel-injection control input produced in order that said lack degree a may maintain a target air-fuel ratio in the configuration of a publication at the time of Air Fuel Ratio Control either.
[0025] The lack degree a can ask for the lack degree which an assumption fuel-injection control input has to the real fuel-injection control input produced in order to maintain a target air-fuel ratio at the time of Air Fuel Ratio Control, and, more specifically, can ask for it as a value reflecting this lack degree.
[0026] The degradation degree of fuel oil consumption appears in a gap of an air-fuel ratio, and the lack degree produced in the assumption fuel-injection control input to the real fuel-injection control input required [since degradation degrees other than fuel oil consumption do not influence] in order to maintain a target air-fuel ratio at the time of Air Fuel Ratio Control can be called thing only showing the degradation degree of the fuel oil consumption in a fuel injection valve.
[0027] Thus, an assumption fuel-injection control input can be amended based on the lack degree a in which the lack degree easily obtained at the time of Air Fuel Ratio Control was made to reflect. And degradation degrees other than fuel oil consumption are easily detectable by asking for the lack degree b which the assumption fuel-injection control input after this amendment has to the real fuel-injection control input in the combustion gestalt A.
[0028] Fuel injection valve degradation detection equipment according to claim 7 is characterized by being [of claims 1-4] a value reflecting the difference of the air-fuel ratio said lack degree a is assumed to be in the configuration of a publication based on an assumption fuel-injection control input, and the real air-fuel ratio based on an assumption fuel-injection control input either.

[0029] The air-fuel ratio assumed based on an assumption fuel-injection control input is more specifically calculated, an air-fuel ratio is further detected actually based on an assumption fuel-injection control input, and the difference of this assumption air-fuel ratio and a real air-fuel ratio is searched for. And it can ask for the lack degree a as a value reflecting this difference. It is not concerned with a combustion gestalt but the difference of the above-mentioned assumption air-fuel ratio and the air-fuel ratio actually detected serves as a value only corresponding to the degradation degree of fuel oil consumption.
[0030] Thus, an assumption fuel-injection control input can be amended based on the lack degree a in which the difference of an assumption air-fuel ratio and the real air-fuel ratio easily obtained by air-fuel ratio measurement was made to reflect. And degradation degrees other than fuel oil consumption are easily detectable by asking for the lack degree b which the assumption fuel-injection control input after this amendment has to the real fuel-injection control input in the combustion gestalt A.
[0031] Fuel injection valve degradation detection equipment according to claim 8 is characterized by said lack degree a being a value reflecting the difference of the combustion pressure assumed based on the assumption fuel-injection control input in the combustion gestalt B, and the real combustion pressure based on an assumption fuel-injection control input in a configuration according to claim 3 or 4.
[0032] The lack degree a can ask for the combustion pressure assumed based on the assumption fuel-injection control input in the combustion gestalt B, and, more specifically, can ask for it as a value reflecting the difference of this assumption combustion pressure and real combustion pressure.
[0033] With the combustion gestalt B with which degradation degrees other than fuel oil consumption cannot influence flammability easily, the difference of the above-mentioned assumption combustion pressure and real combustion pressure can be called what expresses mostly the degradation degree of the fuel oil consumption in a fuel injection valve.
[0034] Thus, an assumption fuel-injection control input can be amended based on the lack degree a in which the difference of assumption combustion pressure and the real combustion pressure easily obtained by combustion pressure measurement was made to reflect. And degradation degrees other than fuel oil consumption are easily detectable by asking for the lack degree b which the assumption fuel-injection control input after this amendment has to the real fuel-injection control input in the combustion gestalt A.
[0035] Fuel injection valve degradation detection equipment according to claim 9 is characterized by being [of claims 1-8] the lack degree which the assumption fuel-injection control input after said amendment has to the real fuel-injection control input produced in order that said lack degree b may maintain an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A either.
[0036] More specifically, it can ask for the lack degree b from the real fuel-injection control input produced in order to maintain an idle target rotational frequency at the time of the idle in the combustion gestalt A as a lack degree which the assumption fuel-injection control input amended based on the lack degree a has.
[0037] With the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability, it can ask for the lack degree b from the real fuel-injection control input produced in order to maintain an idle target rotational frequency at the time of an idle by the lack degree which the assumption fuel-injection control input amended based on the lack degree a has. Degradation degrees other than fuel oil consumption are detectable with this.
[0038] Fuel injection valve degradation detection equipment according to claim 10 is characterized by being [of claims 1-8] a value reflecting the difference of the real air-fuel ratio at the time of said lack degree b maintaining an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A, and the assumption air-fuel ratio based on the assumption fuel-injection control input after said amendment either.
[0039] More specifically, it can ask for the lack degree b as a value reflecting the difference of the real air-fuel ratio at the time of maintaining an idle target rotational frequency at the time of the idle in the combustion gestalt A, and the assumption air-fuel ratio based on the assumption fuel-injection

control input amended based on the lack degree a.
[0040] With the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability, only degradation degrees other than fuel oil consumption are reflecting the difference of the real air-fuel ratio at the time of maintaining an idle target rotational frequency at the time of an idle, and the assumption air-fuel ratio based on the assumption fuel-injection control input amended based on the lack degree a. Therefore, it can ask for the lack degree b reflecting this difference, and degradation degrees other than fuel oil consumption can be detected.
[0041] Fuel injection valve degradation detection equipment according to claim 11 is characterized by being [of claims 1-8] a value reflecting a difference with the air-fuel ratio said lack degree b is assumed to be in the configuration of a publication based on the real air-fuel ratio in the combustion gestalt A, and the assumption fuel-injection control input after said amendment either.
[0042] More specifically, the lack degree b can be made into the value reflecting the difference of the real air-fuel ratio in the combustion gestalt A, and the air-fuel ratio assumed based on the assumption fuel-injection control input amended based on the lack degree a.
[0043] With the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability, only degradation degrees other than fuel oil consumption are reflecting the difference of the real air-fuel ratio by fuel oil consumption required for operation, and the air-fuel ratio assumed based on the assumption fuel-injection control input amended based on the lack degree a. Therefore, it can ask for the lack degree b reflecting this difference, and degradation degrees other than fuel oil consumption can be detected.
[0044] Fuel injection valve degradation detection equipment according to claim 12 is characterized by being [of claims 1-8] a value reflecting the difference of the real air-fuel ratio at the time of said lack degree b maintaining an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A, and the real air-fuel ratio at the time of carrying out fuel injection based on the assumption fuel-injection control input after said amendment either.
[0045] More specifically, the lack degree b can be made into the value which reflected the difference of the real air-fuel ratio at the time of maintaining an idle target rotational frequency, and the real air-fuel ratio at the time of carrying out fuel injection based on the assumption fuel-injection control input amended by the lack degree a at the time of the idle in the combustion gestalt A.
[0046] With the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability, only degradation degrees other than fuel oil consumption are reflecting the difference of the real air-fuel ratio at the time of maintaining an idle target rotational frequency at the time of an idle, and the real air-fuel ratio at the time of carrying out fuel injection based on the assumption fuel-injection control input amended by the lack degree a. Therefore, it can ask for the lack degree b reflecting this difference, and degradation degrees other than fuel oil consumption can be detected.
[0047] Fuel injection valve degradation detection equipment according to claim 13 is characterized by being [of claims 1-8] a value reflecting the difference of the real combustion pressure at the time of said lack degree b maintaining an idle target rotational frequency in the configuration of a publication at the time of the idle in the combustion gestalt A, and the real combustion pressure at the time of carrying out fuel injection based on the assumption fuel-injection control input after said amendment either.
[0048] More specifically, the lack degree b can be made into the value which reflected the difference of the real combustion pressure at the time of maintaining an idle target rotational frequency, and the real combustion pressure at the time of carrying out fuel injection based on the assumption fuel-injection control input amended by the lack degree a at the time of the idle in the combustion gestalt A.
[0049] With the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability, only degradation degrees other than fuel oil consumption are reflecting the difference of the real combustion pressure at the time of maintaining an idle target rotational frequency at the time of an idle, and the real combustion pressure at the time of carrying out fuel injection based on

the assumption fuel-injection control input amended by the lack degree a. Therefore, it can ask for the lack degree b reflecting this difference, and degradation degrees other than fuel oil consumption can be detected.
[0050] Fuel injection valve degradation detection equipment according to claim 14 It is fuel injection valve degradation detection equipment which detects degradation degrees other than the injection quantity in the fuel injection valve used in order to form gaseous mixture with an internal combustion engine. Among the lack degrees which it has to a real fuel-injection control input, the assumption fuel-injection control input in the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability It is characterized by having a degradation degree detection means to detect degradation degrees other than the fuel oil consumption in a fuel injection valve, based on the lack degree b of the part except the lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve.
[0051] It can ask for the lack degree of the assumption fuel-injection control input which the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption are reflecting in the combustion gestalt A with which the degradation degree of the fuel oil consumption in a fuel injection valve and degradation degrees other than fuel oil consumption influence flammability. However, in having detected the lack degree which the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption compounded in this way, the degradation degree of fuel oil consumption and degradation degrees other than fuel oil consumption are inseparable.
[0052] However, since the lack degree b of the part except the lack degree a based on the degradation degree of the fuel oil consumption in a fuel injection valve is detectable also in the combustion gestalt A, degradation degrees other than fuel oil consumption are detectable with the lack degree b.
[0053] A fuel-injection control input adjusts and fuel injection valve degradation detection equipment according to claim 15 is characterized by to obtain the lack degree which the this adjusted fuel-injection control input has to the real fuel-injection control input for attaining the target rotational frequency at the time of the idle in the combustion gestalt A as said lack degree b in a configuration according to claim 14 so that it may become the air-fuel ratio which attained the target rotational frequency in early stages at the time of the idle in the combustion gestalt A.
[0054] Here, the air-fuel ratio which attained the target rotational frequency in early stages means the air-fuel ratio obtained when fuel-oil-consumption control was performed, in order to attain a target rotational frequency in the initial actuation after loading of an internal combustion engine at the time of the idle in the combustion gestalt A.
[0055] The amendment for lack degree a minutes based on the degradation degree of fuel oil consumption [in / in the fuel-injection control input adjusted so that it might become this early air-fuel ratio / a fuel injection valve] is already included. For this reason, the lack degree which this adjusted fuel-injection control input has to the real fuel-injection control input for attaining the target rotational frequency at the time of the idle in the combustion gestalt A corresponds to the lack degree b.
[0056] Thus, even if it does not ask for the lack degree a directly, it can ask for the lack degree b. Fuel injection valve degradation detection equipment according to claim 16 is characterized by said lack degree b being a value reflecting the difference of the air-fuel ratio for attaining a target rotational frequency at the time of the idle in the combustion gestalt A, and the air-fuel ratio which attained the target rotational frequency in early stages in a configuration according to claim 14.
[0057] It seems that a part for the recital of said claim 15 described the air-fuel ratio which attained the target rotational frequency in early stages here. The lack degree b is related to the difference of the air-fuel ratio of this first stage, and the air-fuel ratio for attaining a target rotational frequency in this time. In this way, it can ask for the lack degree b, without computing the lack degree a.
[0058] An internal combustion engine control unit according to claim 17 is characterized by having an amendment means to amend the engine controlled variable in the combustion gestalt A using degradation degrees other than the fuel oil consumption calculated with this fuel injection valve degradation detection equipment while it is equipped with fuel injection valve degradation detection

equipment according to claim 1 to 16.
[0059] Thus, the precise and suitable engine control of an amendment means is attained with the combustion gestalt A which tends to be influenced by degradation degrees other than the injection quantity by amending the engine controlled variable in the combustion gestalt A using degradation degrees other than the fuel oil consumption calculated with fuel injection valve degradation detection equipment according to claim 1 to 16.
[0060]
[Embodiment of the Invention] [Gestalt 1 of operation] drawing 1 shows the outline configuration of the gasoline engine (it abbreviates to an "engine" hereafter) 2 to which invention mentioned above was applied. Drawing 2 expresses the block diagram of the control system of this engine 2. An engine 2 is a jump-spark-ignition type, and is constituted as a cylinder-injection-of-fuel type internal combustion engine, and is carried in the car as an object for automobile actuation.
[0061] The engine 2 has six cylinder 2a. As shown also in drawing 3 - drawing 6 , the combustion chamber 10 divided by the piston 6 which reciprocates within a cylinder block 4 and a cylinder block 4, and the cylinder head 8 attached on the cylinder block 4 is formed in each cylinder 2a, respectively.
[0062] And the exhaust valve 16 of 1st inlet-valve 12a, 2nd inlet-valve 12b, and a couple is formed in each combustion chamber 10, respectively. 1st inlet-valve 12a is connected to 1st inlet port 14a among this, 2nd inlet-valve 12b is connected to 2nd inlet port 14b, and the exhaust valve 16 of a couple is connected to the exhaust port 18 of a couple, respectively.
[0063] Drawing 3 is the horizontal sectional view of the cylinder head 8 for 1 cylinder, and 1st inlet port 14a and 2nd inlet port 14b are straight-way-type inlet ports which extend in the shape of an abbreviation straight line so that it may be illustrated. Moreover, the ignition plug 20 is arranged in the center section of the internal surface of the cylinder head 8. Furthermore, the fuel injection valve 22 is arranged at the internal-surface periphery of the cylinder head 8 1st inlet-valve 12a and near the 2nd inlet-valve 12b so that a direct fuel can be injected in a combustion chamber 10. This fuel injection valve 22 is set up so that the inflammable mixture of a stratification condition may reach at an ignition plug 20 at the time of ignition at the time of the stratification combustion mentioned later, and injection configurations, such as the direction of fuel injection and breadth of fuel Myst, may be in a suitable condition.
[0064] And the high voltage fuel is supplied through the fuel distribution tube (graphic display abbreviation) from the high voltage fuel pump (graphic display abbreviation) driven by revolution of an engine 2 to this fuel injection valve 22. The pressure of this high voltage fuel is adjusted in the suitable condition for injection into a combustion chamber 10 by the electronic control unit ("ECU" is called hereafter) 60 mentioned later. namely, the electromagnetism by which ECU60 was formed in the high voltage fuel pump -- fuel pressure control is performed by adjusting the actuation duty of the spill valve 55 (drawing 2) according to the fuel pressure P in the fuel distribution tube detected in fuel-pressure sensor 50a (drawing 2), and the operational status of an engine 2.
[0065] In addition, a X-X sectional view [in / drawing 4 , and / in drawing 5 / drawing 3] and drawing 6 are the Y-Y sectional views in drawing 3 . [the top view of the top face of a piston 6] The crevice 24 which has the profile configuration of the dome shape prolonged from the lower part of a fuel injection valve 22 to the lower part of an ignition plug 20 is formed in the top face of the piston 6 formed in abbreviation Yamagata so that it might be illustrated.
[0066] As shown in drawing 1 , 1st inlet port 14of each cylinder 2a a is connected to the surge tank 32 through 1st inhalation-of-air path 30a formed in the inlet manifold 30. Moreover, 2nd inlet port 14b is connected with the surge tank 32 through 2nd inhalation-of-air path 30b. In this and each 2nd inhalation-of-air path 30b, the air-current control valve 34 is arranged, respectively. While connecting through the common shaft 36, closing motion actuation of these air-current control valves 34 is carried out by the negative pressure type actuator 37 through this shaft 36. In addition, when the air-current control valve 34 is made into a closed state, the turning style S strong in a combustion chamber 10 (drawing 3) arises by the inhalation of air inhaled only from 1st inlet port 14a.
[0067] The surge tank 32 is connected with the air cleaner 42 through the air intake duct 40. In the air intake duct 40, the throttle valve 46 driven by the motor 44 (a DC motor or step motor) is arranged. While the opening (throttle opening TA) of this throttle valve 46 is detected by throttle

opening sensor 46a, according to operational status, opening control of the throttle valve 46 is carried out. Moreover, each exhaust port 18 of each cylinder 2a is connected with the exhaust manifold 48. The exhaust manifold 48 purified exhaust air through the catalytic converter 49, and has discharged it outside.
[0068] As shown in drawing 2 , ECU60 consisted of a digital computer and is equipped with CPU (microprocessor) 60b, ROM(read-only memory) 60c, RAM(random access memory) 60d mutually connected through bi-directional-bus 60a, backup RAM60e, 60f of input circuits, and 60g of output circuits.
[0069] Throttle opening sensor 46a which detects the throttle opening TA has inputted the output voltage proportional to the opening TA of a throttle valve 46 into 60f of input circuits. The accelerator opening sensor 76 was attached in the accelerator pedal 74, and the output voltage proportional to the amount ACCP of treading in of an accelerator pedal 74 is inputted into 60f of input circuits. The rotational frequency sensor 82 generated the output pulse, whenever 10 degrees (graphic display abbreviation) of crankshafts rotated, and it has inputted this output pulse into 60f of input circuits. Based on the revolution of the cam shaft for driving inlet valves 12a and 12b, the cylinder distinction sensor 84 generated the output pulse, when the No. 1 cylinder of the cylinder 2a reached an inhalation-of-air top dead center, and it has inputted this output pulse into 60f of input circuits. In CPU60b, the current crank angle was calculated from the output pulse of the cylinder distinction sensor 84, and the output pulse of the rotational frequency sensor 82, and the engine speed NE is calculated from the frequency of the output pulse of the rotational frequency sensor 82.
[0070] Moreover, the coolant temperature sensor 86 was formed in the cylinder block 4 of an engine 2, the circulating water temperature THW of an engine 2 was detected, and the output voltage according to a circulating water temperature THW is inputted into 60f of input circuits. The intake-pressure sensor 88 was formed in the surge tank 32, and the output voltage corresponding to the intake pressure PM in a surge tank 32 (the pressure of inhalation air: absolute pressure) is inputted into it at 60f of input circuits. The oxygen sensor (O2 sensor) 90 was formed in the exhaust manifold 48, and the output voltage Vox according to the oxygen constituent concentration under exhaust air is inputted into 60f of input circuits. Fuel-pressure sensor 50a prepared in the fuel distribution tube mentioned above has inputted the output voltage according to the fuel pressure P in a fuel distribution tube into 60f of input circuits. The electrical potential difference VB of the dc-battery 92 carried is inputted into 60f of input circuits. Moreover, the speed sensor 94 was formed in the output side of transmission (graphic display abbreviation), and the signal according to the vehicle speed SPD is inputted into 60f of input circuits based on a revolution of the output shaft of transmission.
[0071] 60g of output circuits -- each fuel injection valve 22, the negative pressure type actuator 37, the motor 44 for actuation of a throttle valve 46, and electromagnetism -- it connects with the spill valve 55, an ignitor 100, and the starter motor 102, and actuation control of each actuator equipments 22, 37, 44, and 55,100,102 is carried out if needed.
[0072] Next, the fuel-injection control performed after the completion of start up in an engine 2 is explained. Combustion gestalt setting-out processing in which the combustion gestalt according to a operating range is set as the flow chart of drawing 7 is shown. This processing is processing which is set up beforehand and which is periodically performed for every crank angle. In addition, each processing step in each flow chart explained below is expressed with "S-."
[0073] First, the amount ACCP of treading in of the accelerator pedal 74 obtained from the signal of the engine speed NE obtained from the signal of the engine-speed sensor 82 and the accelerator opening sensor 76 (an accelerator opening is called hereafter) is read into the working area which is RAM60d (S100).
[0074] Next, the Lean fuel oil consumption QL is computed based on an engine speed NE and the accelerator opening ACCP (S110). In case this Lean fuel oil consumption QL performs stratification combustion, it expresses the optimal fuel oil consumption for making the output torque of an engine 2 into demand torque. The Lean fuel oil consumption QL is beforehand calculated by experiment, and as shown in drawing 8 , it is memorized in ROM60c as a map which makes a parameter the accelerator opening ACCP and an engine speed NE. At step S110, the Lean fuel oil consumption QL is computed based on this map. In addition, since the numeric value is discretely arranged on the map, when the value which is in agreement as a parameter does not exist, it will ask by interpolation

count. Calculation from the map by such interpolation is similarly performed, when calculating a required numeric value from maps other than the map described here.

[0075] Next, based on the Lean fuel oil consumption QL and an engine speed NE, either of three combustion gestalten Rl, R2, and R3 as shown in the map of drawing 9 is set up (S115). In this way, this processing is once ended. In addition, the map of drawing 9 sets up a suitable combustion gestalt according to the Lean fuel oil consumption QL and an engine speed NE by experiment beforehand, and is memorized in ROM60c as a map which makes a parameter the Lean fuel oil consumption QL and an engine speed NE.

[0076] Thus, setting out of a combustion gestalt controls a fuel-injection gestalt according to set-up combustion gestalt Rl-R3. That is, as shown in drawing 9 , the Lean fuel oil consumption QL and an engine speed NE inject the fuel of an amount according to the Lean fuel oil consumption QL in the compression stroke last stage with the combustion gestalt R1 of a field smaller than a borderline QQ1. The injection fuel by injection in this compression stroke last stage collides with the circumferential wall surface 26 (drawing 4 , 5) of a crevice 24, after running in the crevice 24 of a piston 6 from a fuel injection valve 22. It moves being made to evaporate the fuel which collided with the circumferential wall surface 26, and forms a combustible-gas-mixture layer in the about 20-ignition plug crevice 24. And when ignition is made by the combustible gas mixture of the shape of this layer with an ignition plug 20, stratification combustion (it is equivalent to the combustion gestalt A) is performed as a combustion gestalt. The combustion stabilized by this in the combustion chamber in which very superfluous inhalation air exists to a fuel can be made to perform.

[0077] Moreover, the Lean fuel oil consumption QL and an engine speed NE inject the fuel of an amount according to the Lean fuel oil consumption QL in 2 steps in an intake stroke and the compression stroke last stage with the combustion gestalt R2 which it is between a borderline QQ1 and a borderline QQ2. That is, 1st fuel injection is carried out to an intake stroke, and, subsequently to the compression stroke last stage, 2nd fuel injection is performed. The 1st injection fuel flows in a combustion chamber 10 with inhalation air, and a homogeneous lean mixture is formed in [whole] a combustion chamber 10 with this injection fuel. Moreover, as a result of performing 2nd fuel injection in the compression stroke last stage, as mentioned above, a combustible-gas-mixture layer is formed in the about 20-ignition plug crevice 24. And the lean mixture which ignition is made by the combustible gas mixture of the shape of this layer with an ignition plug 20, and occupies the whole inside of a combustion chamber 10 with this ignition flame burns. That is, with the combustion gestalt R2, weak stratification combustion of whenever [stratification] is performed rather than the combustion gestalt R1 mentioned above. By this, smooth torque change can be realized by the staging area which connects the combustion gestalt R1 and the combustion gestalt R3. Hereafter, this combustion gestalt is called "weak stratification combustion." This "weak stratification combustion" is a kind of stratification combustion.

[0078] With the combustion gestalt R3 when the Lean fuel oil consumption QL and an engine speed NE are larger than a borderline QQ2, the fuel quantity which performed various kinds of amendments based on the theoretical-air-fuel-ratio basic fuel oil consumption QBS is injected by the intake stroke. With the inflow of inhalation air, this injection fuel flows in a combustion chamber 10, and flows to ignition. this -- the homogeneity of theoretical air fuel ratio (controlled by loading amendment by the rich air-fuel ratio with fuel concentration deeper than theoretical air fuel ratio to mention later) homogeneous in [whole] a combustion chamber 10 -- gaseous mixture is formed, consequently homogeneity combustion (it is equivalent to the combustion gestalt B) is performed as a combustion gestalt.

[0079] Next, the flow chart of the fuel-oil-consumption control processing performed based on a combustion gestalt is shown in drawing 10 . This processing is processing which is set up beforehand and which is periodically performed for every crank angle.

[0080] Initiation of fuel-oil-consumption control processing reads into the working area of RAM60d the air-fuel ratio detection value Vox acquired from the signal of engine-speed NE first obtained from the signal of the accelerator opening ACCP obtained from the signal of the accelerator opening sensor 76, and the engine-speed sensor 82, the intake pressure PM obtained from the signal of the intake-pressure sensor 88, and an oxygen sensor 90 (S120).

[0081] Next, it is judged whether current and the combustion gestalt R3 are set up (S126). Here, it is

set up based on the combustion gestalt setting-out processing (drawing 7) mentioned above, and also the combustion gestalt is set up according to various conditions. When judged with the combustion gestalt R3 being set up, the theoretical-air-fuel-ratio basic fuel oil consumption QBS is computed from an intake pressure PM and an engine speed NE using the map of "YES") and drawing 11 beforehand set as ROM60c by (S126 (S130).

[0082] Next, heavy load loading OTP calculation processing (S140) is performed. This heavy load loading OTP calculation processing is explained based on the flow chart of drawing 12 . In heavy load-loading OTP calculation processing, it is judged first whether the accelerator opening ACCP is over the heavy load loading decision value KOTPAC (S141). If it is ACCP<=KOTPAC (it is "NO" at S141), a value "0" will be set to the heavy load loading OTP (S142). That is, loading amendment of a fuel is not performed. In this way, it once comes out of heavy load loading OTP calculation processing.

[0083] On the other hand, if it is ACCP>KOTPAC (it is "YES" at S141), a value M (for example, 1> M>0) will be set to the heavy load loading OTP (S144). That is, activation of loading amendment of a fuel is set up. This loading amendment is made in order to prevent that a catalytic converter 49 is overheated at the time of a heavy load.

[0084] After the heavy load loading OTP is computed by drawing 10 at return and step S140, it is judged whether air-fuel ratio feedback (F/B) conditions are satisfied (S150). For example, it is not at the "(1) start-up time. (2) The completion of warming-up is carried out. (For example, circulating-water-temperature THW>=40 degree C) Activation has completed the (3) oxygen sensor 90. (4) The value of the heavy load loading OTP is 0. It is judged whether all the conditions that are " are satisfied.

[0085] If air-fuel ratio feedback conditions are satisfied (it is "YES" at S150), calculation of the air-fuel ratio feedback multiplier FAF and its study value KG will be performed (S160). The air-fuel ratio feedback multiplier FAF is computed based on the output of an oxygen sensor 90. Moreover, the study value KG memorizes the amount of gaps from the central value 1.0 in the air-fuel ratio feedback multiplier FAF. In addition, the case where it is in study value KG=1.0 is a case where the constant gap from central value 1.0 has not arisen for the air-fuel ratio feedback multiplier FAF. Various technique is known as the feed-back-control-of-air-fuel-ratio technique using these values is shown in JP,6-10736,A etc.

[0086] On the other hand, if air-fuel ratio feedback conditions are not satisfied (it is "NO" at S150), 1.0 is set to the air-fuel ratio feedback multiplier FAF (S170). It is steps S160 or S170, next the real fuel-injection control input Q is calculated like the degree type 1 (S180).

[0087]

[Equation 1]

Q <- QBS {1 +OTP+(FAF-1.0)+} (KG-1.0) alpha + beta -- [Formula 1]

Here, alpha and beta are multipliers suitably set up according to the class of engine 2, or the content of control. At the time of homogeneity combustion (combustion gestalt R3), this real fuel-injection control input Q is set up as valve-opening time amount TAU of a fuel injection valve 22, and the fuel of an amount according to the real fuel-injection control input Q is injected in a combustion chamber 10 at the time of an intake stroke.

[0088] If the real fuel-injection control input Q is computed at step S180, this processing will once be ended. In addition, in the combustion gestalt R3 which is performing homogeneity combustion in this way, by driving the motor 44 for actuation of a throttle valve 46, in being an idle state, it is not illustrating, but ECU60 adjusts the throttle opening TA, and it is controlling it so that an engine speed NE turns into the target idle rpm NT.

[0089] on the other hand -- a step -- S -- 126 -- combustion -- a gestalt -- R -- three -- except -- combustion -- a gestalt -- namely, -- combustion -- a gestalt -- R -- one -- R -- two -- either -- setting up -- having -- **** -- ** -- judging -- having had -- a case -- (-- S -- 126 -- "-- NO -- " --) -- next -- a stratification - weakness -- a stratification -- combustion -- the time -- fuel oil consumption -- control -- processing -- performing -- having (S200) . Fuel-oil-consumption control processing is shown in the flow chart of drawing 13 at the time of a stratification and weak stratification combustion.

[0090] By fuel-oil-consumption control processing, it is first judged at the time of this stratification and weak stratification combustion whether it is at the idle time (S210). If it is at the idle time (it is

"YES" at S210), engine-speed deflection deltaNE will be computed based on the target idle rpm NT and an engine speed NE like the degree type 2 next (S220).
[0091]
[Equation 2]
deltaNE <- NT - NE -- [Formula 2]
Next, according to engine-speed deflection deltaNE, the real fuel-injection control input Q for controlling an engine speed NE to the target idle rpm NT is computed by the feedback count fidl (S230). Thus, as an engine speed NE turns into the target idle rpm NT with the calculated real fuel-injection control input Q, idle rpm feedback control is made.
[0092] Moreover, when it is not at the idle time, it is read into "NO") and the working area whose operation addition time amount Texe of an engine 2 is RAM60d by (S210 (S240). This operation addition time amount Texe expresses the total elapsed time after an engine 2 starts operation first after car loading. The operation addition time amount Texe is counted with the timer of the ECU60 interior at the time of operation of an engine 2, and is memorized as an integrated value in backup RAM60e. In addition, the total engine turnover number after the mileage or the engine 2 of a car with which the engine 2 was carried in addition to such operation elapsed time starts operation first may be used.
[0093] Next, based on this operation addition time amount Texe, the assumption fuel-injection control input lowering multiplier qx is computed from the map shown in drawing 14 (S250). With operation progress of an engine 2, according to the adjustment effectiveness of an engine 2 and its actuation system, the map shown in drawing 14 is that the friction of an engine 2 and its actuation system decreases, and expresses the rate that the fuel-injection control input which the same output torque takes falls. That is, although it is assumption fuel-injection control input lowering multiplier qx=1.0 at the beginning [of operation] after car loading of an engine 2, the assumption fuel-injection control input lowering multiplier qx falls gradually by reduction of the friction accompanying the increment in the operation addition time amount Texe. And after [a certain amount of] falling, it is shown that the assumption fuel-injection control input lowering multiplier qx serves as a stable value.
[0094] Next, the assumption fuel-injection control input Qy as shown in the degree type 3, in case there is no degradation of a fuel injection valve 22 based on the assumption fuel-injection control input lowering multiplier qx computed at the Lean fuel oil consumption QL and step S250 which were computed at step S110 of combustion gestalt setting-out processing (drawing 7) is computed (S260).
[0095]
[Equation 3]
Qy <- QL-qx -- [Formula 3]
Next, the map shown in drawing 18 based on Dvol whenever [quantitative degradation / which is mentioned later] to this assumption fuel-injection control input Qy and the amount Qvol of quantitative injection amendments are computed (S270). The map of drawing 18 converts Dvol into the amount of gaps on the fuel-injection control input at the time of actual stratification combustion (combustion gestalt R1) and weak stratification combustion (combustion gestalt R2) whenever [quantitative degradation / which was obtained at the time of homogeneity combustion] so that it may mention later, it is called for by an experiment or count, and is beforehand memorized in ROM60c.
[0096] And next, as shown in the degree type 4, the real fuel-injection control input Q is computed by amending the assumption fuel-injection control input Qy in the amount Qvol of quantitative injection amendments (S280).
[0097]
[Equation 4]
Q <- Qy + Qvol -- [Formula 4]
If the real fuel-injection control input Q is computed at step S230 or step S280, this processing will once be ended. In addition, at the time of stratification combustion (combustion gestalt R1), this real fuel-injection control input Q is set up as valve-opening time amount TAU of a fuel injection valve 22, and it is injected in a combustion chamber 10 in the last stage at the time of a compression

stroke. Moreover, at the time of weak stratification combustion (combustion gestalt R2), this real fuel-injection control input Q is divided into two, is set up as valve-opening time amount TAU of a fuel injection valve 22, respectively, and is injected in a combustion chamber 10 in the last stage, respectively at the time of an intake stroke and a compression stroke.
[0098] Next, based on drawing 15 , Dvol detection processing is explained whenever [quantitative degradation]. This processing is processing performed by being the same period after processing of fuel-oil-consumption control processing (drawing 10).
[0099] If Dvol detection processing is started whenever [quantitative degradation], ****** at the time of the idle in current and the combustion gestalt R3 will be judged first (S310). If it is not at the idle time in the combustion gestalt R3 (it is "NO" at S310), "OFF" will be set as the completion flag Fy of Dvol detection whenever [quantitative degradation], and this processing will once be ended. If it is at the idle time in the combustion gestalt R3 (it is "YES" at S310), it will be judged next now whether it is the condition that processing of step S160 of whether it is during feed back control of air-fuel ratio and fuel-oil-consumption control processing (drawing 10) is performed (S330). If it is not during feed back control of air-fuel ratio (it is "NO" at S330), this processing will once be ended as it is.
[0100] If it is during feed back control of air-fuel ratio (it is "YES" at S330) next, it will be judged for the completion flag Fy of Dvol detection whenever [quantitative degradation] whether it is "OFF" (S340). If it is Fy= "ON" (it is "NO" at S340), this processing will once be ended as it is.
[0101] If it is Fy= "OFF" (it is "YES" at S340) next, the operation addition time amount Texe of an engine 2 will be read into the working area which is RAM60d (S350). It seems that step S240 of fuel-oil-consumption control processing (drawing 13) described this operation addition time amount Texe at the time of a stratification and weak stratification combustion.
[0102] Next, based on this operation addition time amount Texe, the assumption fuel-injection control input lowering multiplier qx is computed from the map shown in drawing 14 (S360). It seems that step S250 of fuel-oil-consumption control processing (drawing 13) described the map shown in drawing 14 at the time of a stratification and weak stratification combustion.
[0103] Next, Dvol is computed like the degree type 5 whenever [quantitative degradation] (S370).
[0104]
[Equation 5]
Dvol <- (Q - Qorg-qx) /Q -- [Formula 5]
Here, the fuel-injection control input Q is a real fuel-injection control input currently calculated at step S180 of fuel-oil-consumption control processing (drawing 10) at the time of the idle in homogeneity combustion (combustion gestalt R3). Moreover, Qorg is the fuel-injection control input memorized in the time of a start up after car loading of an engine 2 in the bottom of the same condition as this time. That is, in the time of a start up after car loading of an engine 2, when there is an engine 2 at the time of the idle in homogeneity combustion, it is the value which memorized the fuel-injection control input Q needed for the same target idle rpm NT to backup RAM60e. If it follows, for example, degradation has not arisen at all in the fuel injection valve 22, since it becomes "Qorg-qx=Q", it is set to Dvol=0 at this time.
[0105] Next, "ON" is set as the completion flag Fy of Dvol detection whenever [quantitative degradation] (S380), and Dvol detection processing is once ended whenever [quantitative degradation]. Next, based on drawing 16 , Dshp detection processing is explained whenever [geometrical degradation]. This processing is processing performed by being the same period after processing of fuel-oil-consumption control processing (drawing 10).
[0106] If Dshp detection processing is started whenever [geometrical degradation], ****** at the time of the idle in the combustion gestalt R1 will be judged first (S410). If it is not at the idle time in the combustion gestalt R1 (it is "NO" at S410), "OFF" will be set as the completion flag Fx of Dshp detection whenever [geometrical degradation] (S420), and this processing will once be ended.
[0107] If it is at the idle time in the combustion gestalt R1 (it is "YES" at S410) next, it will be judged for the completion flag Fx of Dshp detection whenever [geometrical degradation] whether it is "OFF" (S430). If it is Fx= "ON" (it is "NO" at S430), this processing will once be ended.
[0108] If it is Fx= "OFF" (it is "YES" at S430) next, it will be judged whether the engine speed NE is stable at the target rotational frequency NT (S440). For example, it judges between the

conventional times by whether the engine speed NE exists by criteria within the limits to the target rotational frequency NT. If the engine speed NE is not stable at the target rotational frequency NT (it is "NO" at S440), this processing is once ended as it is.
[0109] If the engine speed NE is stable at the target rotational frequency NT (it is "YES" at S440), as shown in the degree type 6 below, the assumption fuel-injection control input Qx will be computed (S450). This assumption fuel-injection control input Qx is equivalent to the fuel-injection control input set up when there is no degradation in a fuel injection valve 22.
[0110]
[Equation 6]
Qx <- Qorgs-qx -- [Formula 6]
Here, Qorgs is the fuel-injection control input memorized in the time of a start up after car loading of an engine 2 in the bottom of the same condition as this time. That is, in the time of a start up after car loading of an engine 2, it is the value which memorized the fuel-injection control input needed for the case at the time of the idle in stratification combustion (combustion gestalt R1) at the same target idle rpm NT to backup RAM60e.
[0111] Next, the amount Qvol of quantitative injection amendments is computed from the map shown in drawing 18 based on Dvol whenever [this assumption fuel-injection control input Qx and quantitative degradation / which is computed at step S370 of Dvol detection processing (drawing 15) whenever / quantitative degradation] (S460). It seems that step S270 of fuel-oil-consumption control processing (drawing 13) described the map of drawing 18 at the time of a stratification and weak stratification combustion.
[0112] And using the amount Qvol of quantitative injection amendments and the assumption fuel-injection control input Qx which were computed by having carried out in this way, as shown in the degree type 7, the assumption fuel-injection control input Qz after amendment is computed (S470).
[0113]
[Equation 7]
Qz <- Qx + Qvol -- [Formula 7]
Thus, the assumption fuel-injection control input Qz after amendment calculated when the assumption fuel-injection control input Qx is amended by the amount Qvol of quantitative injection amendments will assume the fuel-injection control input when only degradation on fuel oil consumption arises.
[0114] Next, it is computed as variation deltaDshp shows in the degree type 8 whenever [geometrical degradation] (S480).
[0115]
[Equation 8]
deltaDshp <- (Q - Qz) /Q -- [Formula 8]
This formula 8 expresses change of the inflammable aggravation degree by factors, such as a fuel-injection configuration, called the direction of the change of whenever [of those other than fuel oil consumption / degradation] from a fuel injection valve 22 to into a combustion chamber 10, for example, fuel injection, and breadth of fuel Myst in the fuel injection valve 22. In addition, the fuel-injection control input Q is the real fuel-injection control input Q computed by feedback count of step S230 of fuel-oil-consumption control processing (drawing 13) at the time of a stratification and weak stratification combustion at the time of the idle in stratification combustion (combustion gestalt R1).
[0116] Next, Dshp is computed whenever [geometrical degradation] like the degree type 9 (S490).
[0117]
[Equation 9]
Dshp <- Dshp + deltaDshp -- [Formula 9]
As for the initial value of Dshp, "0" is set up whenever [in the beginning when the engine 2 was carried in the car / geometrical degradation]. Therefore, when step S490 is performed first, deltaDshp, i.e., "/(Q - Qz) Q", is set to Dshp whenever [geometrical degradation]. And from the 2nd time, the amendment for variation deltaDshp to have arisen whenever [geometrical degradation] will be made by said formula 9 to Dshp whenever [geometrical degradation].
[0118] Next, "ON" is set as the completion flag Fx of Dshp detection whenever [geometrical

degradation] (S500), and it once comes out of this processing. In addition, with the gestalt 1 of this operation, as mentioned above, a series of processing steps S450-S490 which detect Dshp whenever [geometrical degradation] are not performed at the time of the idle in weak stratification combustion (combustion gestalt R2) (being S410 "NO"). Since not all the real fuel-injection control inputs Q will be in a stratification condition in weak stratification combustion, this is because Dshp is [whenever / geometrical degradation] uncomputable to accuracy in the same computation as the time of the idle of the combustion gestalt R1 from which all the real fuel-injection control inputs Q will be in a stratification condition.
[0119] Thus, as an example of processing using Dshp, fuel-injection-timing control processing is shown in the flow chart of drawing 17 whenever [geometrical degradation / which was called for]. This processing is processing performed following on fuel-oil-consumption control processing (drawing 10), and is performed a fixed crank angle period.
[0120] Initiation of this processing reads Dshp into the working area which is RAM60d first whenever [engine-speed NE, real fuel-injection control input Q, and geometrical degradation] (S510). Next, it is judged whether it is the combustion gestalt R1 (stratification combustion) (S512). If it is the combustion gestalt R1 (it is "YES" at S512), it will compute from the map which shows the fuel injection timing Ainj for a stratification below to drawing 19 based on an engine speed NE and the real fuel-injection control input Q (S514). This map is a map which was set up in order to carry out fuel injection in the compression stroke last stage, and was set up by experiment considering the engine speed NE and the real fuel-injection control input Q as a parameter so that the fuel injected in the combustion chamber 10 in the compression stroke last stage may be in a stratification condition and good flammability might be shown.
[0121] Next, it asks for the amendment fuel injection timing Kinj from a map using Dshp whenever [geometrical degradation / which was called for at step S490 of Dshp detection processing (drawing 16) whenever / geometrical degradation] (S516). This map is set up by experiment in consideration of fluctuation of an engine speed NE, or the fuel consumption optimal location whenever [to a flame failure / allowances]. In addition, although the 1-dimensional map of only Dshp is [whenever / geometrical degradation] sufficient, the two-dimensional map which considered the engine speed NE or the real fuel-injection control input Q with Dshp whenever [geometrical degradation] is sufficient, or the three-dimension map which makes a parameter Dshp, an engine speed NE, and the real fuel-injection control input Q whenever [geometrical degradation] is sufficient.
[0122] Next, the fuel injection timing Einj for a stratification is called for like the degree type 10 by amending the fuel injection timing Ainj for a stratification in the amendment fuel injection timing Kinj (S518).
[0123]
[Equation 10]
Einj <- Ainj + Kinj -- [Formula 10]
In this way, this processing is once ended.
[0124] Next, when it is not the combustion gestalt R1 (it is "NO" at S512), it is judged whether it is the combustion gestalt R2 (S520). Here, if it is the combustion gestalt R2 (weak stratification combustion) (it is "YES" at S520), the real fuel-injection control input Q will be divided into the real fuel-injection control input Q1 for stratification combustion, and the real fuel-injection control input Q2 for homogeneity combustion next (S522). this division -- homogeneity -- gaseous mixture -- the homogeneity which is appropriately lit with an ignition plug 20 and exists in [whole] a combustion chamber 10 when a fuel is injected in the stratification condition inside -- it is beforehand set up at a rate according to operational status so that gaseous mixture may burn good.
[0125] Next, according to the map shown in drawing 19 , the fuel injection timing Ainj for a stratification is computed based on an engine speed NE and the real fuel-injection control input Q1 for stratification combustion (S524). Furthermore, based on Dshp, it asks for the amendment fuel injection timing Kinj whenever [geometrical degradation] on the map explained at step S516 (S526).
[0126] Next, the fuel injection timing Einj for a stratification is called for by amending the fuel injection timing Ainj for a stratification in the amendment fuel injection timing Kinj as well as said formula 10 (S528).

[0127] Next, based on an engine speed NE and the real fuel-injection control input Q2 for homogeneity combustion, the fuel injection timing Finj for homogeneity is computed from the map shown in drawing 20 (S530). This map is a map which was set up in order to carry out fuel injection in an intake stroke, and was set up by experiment considering the engine speed NE and the real fuel-injection control input Q (here real fuel-injection control input Q2 for homogeneity combustion) as a parameter so that the fuel injected in the combustion chamber 10 in intake-stroke injection might serve as homogeneous gaseous mixture and good flammability might be shown.
[0128] In this way, this processing is once ended. Next, when it is the combustion gestalt R3 (it is "NO" at S520), based on an engine speed NE and the real fuel-injection control input Q, the fuel injection timing Finj for homogeneity is computed from a map (S532). It is set up in order to carry out fuel injection of this map in an intake stroke, but since it is in the condition which the air-current control valve 34 drives with the combustion gestalt R3, the map set up apart from drawing 20 is used.
[0129] In this way, this processing is once ended. In the gestalt 1 of operation mentioned above, steps S450-S490 of Dshp detection processing (drawing 16) are [whenever / geometrical degradation] equivalent to the processing as a degradation degree detection means, and steps S516, S518, S526, and S528 are equivalent to the processing as an amendment means. and the assumption fuel-injection control input Qx -- "an assumption fuel-injection control input" -- whenever [quantitative degradation] -- Dvol -- "the degradation degree of fuel oil consumption" -- the amount Qvol of quantitative injection amendments -- "the lack degree a" -- "Q-Qz" is equivalent to "the lack degree b", and Dshp is [whenever / geometrical degradation] equivalent to "the assumption fuel-injection control input after amendment" for the assumption fuel-injection control input Qz after amendment at "degradation degrees other than fuel oil consumption."
[0130] According to the gestalt 1 of this operation explained above, the following effectiveness is acquired.
(**) -- in order to ask for geometrical degradation in the . fuel injection valve 22, the amount Qvol of quantitative injection amendments which calculated the assumption fuel-injection control input Qx in stratification combustion from Dvol whenever [in a fuel injection valve 22 / quantitative degradation] amends first, and the assumption fuel-injection control input Qz after amendment is calculated (S470). And it asks for the lack degree "Q-Qz" which this assumption fuel-injection control input Qz after amendment has to the real fuel-injection control input Q, and variation deltaDshp is calculated whenever [geometrical degradation] by doing the division of this value with the real fuel-injection control input Q (S480). And Dshp is calculated [whenever / this geometrical degradation] by variation deltaDshp whenever [geometrical degradation / which is degradation degrees other than fuel oil consumption] (S490). Thus, Dshp can be calculated whenever [only showing degradation degrees other than fuel oil consumption / geometrical degradation].
[0131] (**) -- about the amount Qvol of . quantitative injection amendments, it is asking by making Dvol (S370) reflect whenever [quantitative degradation / for which it asked from the lack degree of assumption fuel-injection control input Qorg-qx to the real fuel-injection control input Q at the time of homogeneity combustion] (S270, S460). In homogeneity combustion, since degradation degrees other than fuel oil consumption cannot influence flammability easily, Dvol can be calculated whenever [quantitative degradation] from the lack degree in homogeneity combustion. And the amount Qvol of quantitative injection amendments can be calculated from Dvol whenever [this quantitative degradation].
[0132] (Ha) Based on the lack degree "Q-Qorg-qx" of assumption fuel-injection control input Qorg-qx to the real fuel-injection control input Q produced in order [which is .] to maintain an idle target rotational frequency at the time of the idle in homogeneity combustion, Dvol is calculated whenever [quantitative degradation] (S370), and the amount Qvol of quantitative injection amendments is calculated from Dvol whenever [this quantitative degradation] (S460).
[0133] Thus, the data of Dvol can be easily obtained whenever [quantitative degradation] by using the idle state in homogeneity combustion. Therefore, Dshp is [whenever / geometrical degradation] easily detectable by being based on Dvol whenever [this quantitative degradation].
[0134] (**) . -- the suitable fuel injection timing Einj for a stratification is called for using Dshp by asking for the amendment fuel injection timing Kinj (S516, S526), and amending the fuel injection

timing Ainj for a stratification in the amendment fuel injection timing Kinj in fuel-injection-timing control processing (drawing 17), whenever [geometrical degradation / which was called for by doing in this way again] (S518, S528).
[0135] Therefore, precise and suitable engine control is attained also by the stratification combustion which tends to be influenced by degradation degrees other than injection quantity, such as an injection configuration.
With the gestalt 2 of the [gestalt 2 of operation] book operation, it differs in that Dvol detection processing is performed whenever [quantitative degradation / which is shown in drawing 21 instead of Dvol detection processing whenever / quantitative degradation / which was shown in drawing 15 of the gestalt 1 of said operation]. Especially other configurations are the same as the gestalt 1 of said operation, unless it explains.
[0136] By Dvol calculation processing, it is judged first whenever [this / quantitative degradation] whether it is the combustion gestalt R3 (homogeneity combustion) (S550). If it is not the combustion gestalt R3 (it is "NO" at S550), "OFF" will be set as the completion flag Fy of Dvol detection whenever [quantitative degradation] (S555), and this processing will once be ended.
[0137] If it is the combustion gestalt R3 (it is "YES" at S550), it will be judged next whether it is under [feed-back-control-of-air-fuel-ratio] ****** (S560). If there is nothing in feed back control of air-fuel ratio (it is "NO" at S560), this processing will once be ended as it is.
[0138] If it is during feed back control of air-fuel ratio (it is "YES" at S560) next, it will be judged for the completion flag Fy of Dvol detection whenever [quantitative degradation] whether it is "OFF" (S565). If it is Fy= "ON" (it is "NO" at S565), this processing will once be ended as it is.
[0139] If it is Fy= "OFF" (it is "YES" at S565) next, as shown in the degree type 11, Dvol will be computed whenever [quantitative degradation] (S570).
[0140]
[Equation 11]
Dvol <- (KG - KGorg) /KG -- [Formula 11]
Here, KGorg is the study value KG of the air-fuel ratio feedback multiplier FAF memorized at the time of the feed back control of air-fuel ratio in the time of a start up after car loading of an engine 2. That is, when the engine 2 is carrying out feedback control to theoretical air fuel ratio by homogeneity combustion at the time of a start up after car loading, it is the value memorized to backup RAM60e. If it follows, for example, degradation has not arisen at all in the fuel injection valve 22, since it becomes "KG=KGorg", it is set to Dvol=0 at this time.
[0141] If processing of step S570 is completed, "ON" will be set as the completion flag Fy of Dvol detection whenever [quantitative degradation] (S575), and this processing will once be ended. Thus, Dvol can be calculated whenever [quantitative degradation]. And in case Dvol computes the amount Qvol of quantitative injection amendments at step S460 of Dshp detection processing (drawing 16) whenever [geometrical degradation / which was stated with the gestalt 1 of said operation], it is used, and it is used [whenever / this quantitative degradation] for calculation (S450-S490) of Dshp whenever [geometrical degradation]. Moreover, it is used in case the amount Qvol of quantitative injection amendments is computed also at step S270 of fuel-oil-consumption control processing (drawing 13) at the time of a stratification and weak stratification combustion, and it is used for calculation (S280) of the real fuel-injection control input Q.
[0142] In addition, the maps used at steps S460 and S270 differ in the gestalt 1 of said operation, and serve as a content corresponding to having used the study value KG. According to the gestalt 2 of this operation explained above, the following effectiveness is acquired.
[0143] The same effectiveness as (b) of the gestalt 1 of the (b) . aforementioned implementation and (d) is produced.
(**) -- based on a difference with the initial value KGorg in the study value KG of the air-fuel ratio feedback multiplier FAF at the time of . homogeneity combustion, Dvol is calculated whenever [quantitative degradation] (S570), Dvol is made to reflect whenever [this quantitative degradation], and the amount Qvol of quantitative injection amendments is calculated (S460, S270). Since there is no effect by degradation degrees other than fuel oil consumption to the fluctuation which appears in the air-fuel ratio feedback multiplier FAF at the time of feed back control of air-fuel ratio, and the fluctuation from the initial value accumulated in the study value KG here, based

on the fluctuation from the initial value KGorg of the study value KG, Dvol can be calculated whenever [quantitative degradation]. And the amount Qvol of quantitative injection amendments can be calculated from Dvol whenever [this quantitative degradation].
[0144] (Ha) With the gestalt 2 of . book operation, Dvol is calculated whenever [quantitative degradation] using the study value KG calculated at the time of feed back control of air-fuel ratio (S570), and the amount Qvol of quantitative injection amendments is calculated from Dvol whenever [this quantitative degradation] (S460, S270).
[0145] Therefore, in the usual feed back control of air-fuel ratio, the data of Dvol can be obtained easily whenever [quantitative degradation], the amount Qvol of quantitative injection amendments can be used at the time of stratification combustion, and Dshp can be detected easily whenever [geometrical degradation].
[0146] With the gestalt 3 of the [gestalt 3 of operation] book operation, the linear air-fuel ratio sensor is formed instead of the oxygen sensor 90. This linear air-fuel ratio sensor outputs the current signal I according to the air-fuel ratio of the gaseous mixture which appears in the component of exhaust air, as shown in drawing 22 . And after being changed into the air-fuel ratio detection value VAF expressed with an electrical potential difference as shown in drawing 23 within ECU60, based on this air-fuel ratio detection value VAF, feed back control of air-fuel ratio is made, and the air-fuel ratio is adjusted to the target air-fuel ratio by increase-and-decrease processing of amendment of fuel oil consumption.
[0147] And Dvol detection processing is performed [whenever / quantitative degradation / which was shown in drawing 15 of the gestalt 1 of said operation] instead of Dvol detection processing whenever [quantitative degradation / which is shown in drawing 24]. Especially other configurations are the same as the gestalt 1 of said operation, unless it explains.
[0148] If Dvol detection processing (drawing 24) is started whenever [quantitative degradation], the accelerator opening ACCP, engine-speed NE, an intake pressure PM, the air-fuel ratio detection value VAF, the real fuel-injection control input Q, etc. will be first read into the working area of RAM60d (S610).
[0149] Next, it is judged whether Dvol detection conditions are satisfied whenever [quantitative degradation] (S620). Dvol detection conditions are in the condition which is stable whenever [quantitative degradation].
[0150] If Dvol detection conditions are not satisfied whenever [quantitative degradation] (it is "NO" at S620), processing is once ended as it is. If Dvol detection conditions are satisfied whenever [quantitative degradation] (it is "YES" at S620), the inhalation air content Ga inhaled in a combustion chamber 10 next will be computed based on an engine speed NE and an intake pressure PM from the map shown in drawing 25 (S630).
[0151] Next, as shown in the degree type 12, a ratio with the real fuel-injection control input Q calculated at either said step S180 (drawing 10) and said steps S230 and S280 (drawing 13) is computed, and it sets up as an assumption air-fuel ratio AFini (S640).
[0152]
[Equation 12]
$AFini \leftarrow Ga / Q$ -- [Formula 12]
Next, it asks by calculating with the relation fv as showed the actual air-fuel ratio AF by drawing 23 based on the air-fuel ratio detection value VAF by the linear air-fuel ratio sensor (S650).
[0153] Next, as shown in the degree type 13, Dvol is computed whenever [quantitative degradation] (S660).
[0154]
[Equation 13]
$Dvol \leftarrow (AF - AFini) / AF$ -- [Formula 13]
If it follows, for example, degradation has not arisen at all in the fuel injection valve 22, since it becomes "AF=AFini", it is set to Dvol=0 at this time.
[0155] If processing of step S660 is completed, this processing will once be ended. Thus, Dvol can be calculated whenever [quantitative degradation]. And in case Dvol computes the amount Qvol of quantitative injection amendments at steps S460 and S270, it is used, and it is used [whenever / this quantitative degradation] for calculation of Dshp and the real fuel-injection control input Q

whenever [geometrical degradation]. In addition, the maps used at steps S460 and S270 differ in the gestalt 1 of said operation, and serve as a content corresponding to having used the air-fuel ratio AF.
[0156] According to the gestalt 3 of this operation explained above, the following effectiveness is acquired.
The same effectiveness as (b) of the gestalt 1 of the (b) . aforementioned implementation and (d) is produced.
(**) -- about the amount Qvol of . quantitative injection amendments, it is asking by making Dvol (S660) reflect whenever [quantitative degradation / for which it asked from the comparison with the assumption air-fuel ratio AFini assumed that the real air-fuel ratio AF and the real fuel-injection control input Q which are actually detected by the linear air-fuel ratio sensor realize] (S460, S270).
[0157] Thus, since the difference of the real air-fuel ratio AF and the assumption air-fuel ratio AFini does not have the effect by degradation degrees other than fuel oil consumption, based on the difference of the real air-fuel ratio AF and the assumption air-fuel ratio AFini, Dvol can be calculated whenever [quantitative degradation]. And the amount Qvol of quantitative injection amendments can be calculated from Dvol whenever [this quantitative degradation].
[0158] (Ha) By the linear air-fuel ratio sensor, ., in addition the real air-fuel ratio AF cannot choose the operational status of an engine 2, but can always ask accuracy for it directly. Therefore, it is always possible to ask accuracy for Dvol whenever [quantitative degradation], and Dshp can be easily detected whenever [geometrical degradation] using this amount Qvol of quantitative injection amendments at the time of stratification combustion.
[0159] With the gestalt 4 of the [gestalt 4 of operation] book operation, the combustion pressure sensor is formed in the cylinder head 8. And the real mean effective pressure Pi shall be calculated in ECU from the combustion pressure in the combustion chamber 10 detected by the combustion pressure sensor.
[0160] Furthermore, Dvol detection processing is performed [whenever / quantitative degradation / which was shown in drawing 15 of the gestalt 1 of said operation] instead of Dvol detection processing whenever [quantitative degradation / which is shown in drawing 26]. Especially other configurations are the same as the gestalt 1 of said operation, unless it explains.
[0161] If Dvol detection processing (drawing 26) is started whenever [quantitative degradation], engine-speed NE, an intake pressure PM, the real fuel-injection control input Q, the real mean effective pressure Pi, etc. will be first read into the working area which is RAM60d (S710).
[0162] Next, it is judged whether it is the combustion gestalt R3 (S720). If it is not the combustion gestalt R3 (it is "NO" at S720), "OFF" will be set as the completion flag Fy of Dvol detection whenever [quantitative degradation] (S730), and this processing will once be ended.
[0163] If it is the combustion gestalt R3 (it is "YES" at S720) next, it will be judged for the completion flag Fy of Dvol detection whenever [quantitative degradation] whether it is "OFF" (S740). If it is Fy= "ON" (it is "NO" at S740), processing will be ended as it is.
[0164] If it is Fy= "OFF" (it is "YES" at S740) next, the assumption mean effective pressure P assumed with the real fuel-injection control input Q will be computed from the map shown in drawing 27 based on engine-speed NE, an intake pressure PM, and the real fuel-injection control input Q (S750). This map asks for the real mean effective pressure Pi generated in the engine at the time of homogeneity combustion by making engine-speed NE, an intake pressure PM, and the real fuel-injection control input Q into a parameter by experiment beforehand, and is memorized in ROM of ECU.
[0165] Next, as shown in the degree type 14, Dvol is computed whenever [quantitative degradation] (S760).
[0166]
[Equation 14]
Dvol <- (P - Pi) /Pi -- [Formula 14]
If it follows, for example, degradation has not arisen at all in the fuel injection valve 22, since it becomes "P=Pi", it is set to Dvol=0 at this time.
[0167] If processing of step S760 is completed, "ON" will be set as the completion flag Fy of Dvol detection whenever [quantitative degradation] (S770), and this processing will once be ended. Thus, Dvol can be calculated whenever [quantitative degradation]. And in case Dvol computes the

amount Qvol of quantitative injection amendments at steps S460 and S270 of the gestalt 1 of said operation, it is used, and it is used [whenever / this quantitative degradation] for calculation of Dshp and the real fuel-injection control input Q whenever [geometrical degradation]. In addition, the maps used at steps S460 and S270 differ in the gestalt 1 of said operation, and serve as a content corresponding to having used the real mean effective pressure Pi.
[0168] According to the gestalt 4 of this operation explained above, the following effectiveness is acquired.
The same effectiveness as (b) of the gestalt 1 of the (b) . aforementioned implementation and (d) is produced.
(**) -- based on the difference of the assumption mean effective pressure P and the real mean effective pressure Pi at the time of . homogeneity combustion, Dvol is calculated whenever [quantitative degradation] (S760), and the amount Qvol of quantitative injection amendments is calculated by making Dvol reflect whenever [this quantitative degradation] (S460, S270). Since most effects by degradation degrees other than fuel oil consumption cannot be found to fluctuation of mean effective pressure, based on the difference of the assumption mean effective pressure P and the real mean effective pressure Pi, Dvol can be calculated whenever [quantitative degradation] here [the fluctuation and here] where it appears in the combustion pressure at the time of homogeneity combustion. And the amount Qvol of quantitative injection amendments can be calculated from Dvol whenever [this quantitative degradation].
[0169] (Ha) It can ask for ., in addition the combustion pressure in the time of homogeneity combustion directly by high frequency. Therefore, it is possible to always ask accuracy for Dvol whenever [quantitative degradation], and Dshp can be easily detected whenever [geometrical degradation] using this amount Qvol of quantitative injection amendments at the time of stratification combustion.
[0170] With the gestalt 5 of the [gestalt 5 of operation] book operation, processing of drawing 28 is performed whenever [geometrical degradation / of the gestalt 1 of said operation] instead of processing of step S480 of Dshp detection processing (drawing 16). Furthermore, with the gestalt 5 of this operation, the linear air-fuel ratio sensor is formed instead of the oxygen sensor 90. As the gestalt 3 of said operation described, this linear air-fuel ratio sensor outputs the current signal I according to the air-fuel ratio of the gaseous mixture which appears in the component of exhaust air, and is changed into the air-fuel ratio detection value VAF within ECU60. And based on this air-fuel ratio detection value VAF, feed back control of air-fuel ratio is made, and an air-fuel ratio is adjusted to a target air-fuel ratio by increase-and-decrease processing of amendment of fuel oil consumption. Especially other configurations are the same as the gestalt 1 of said operation, unless it explains.
[0171] Processing of processing of step S470 of Dshp detection processing (drawing 16), next drawing 28 is performed whenever [geometrical degradation]. The inhalation air content Ga first inhaled in a combustion chamber 10 is computed based on an engine speed NE and an intake pressure PM from the same map with having been shown in drawing 25 (S810).
[0172] Next, as shown in the degree type 15, the ratio of the inhalation air content Ga and the assumption fuel-injection control input Qz after amendment currently calculated at said step S470 (drawing 16) is computed, and it sets up as an after [amendment] assumption air-fuel ratio AFz (S820).
[0173]
[Equation 15]
AFz <- Ga / Qz -- [Formula 15]
Next, it asks by calculating with the relation fv as showed the real air-fuel ratio AF by drawing 23 based on the air-fuel ratio detection value VAF by the linear air-fuel ratio sensor (S830).
[0174] Next, as shown in the degree type 16, variation deltaDshp is computed whenever [geometrical degradation] (S840).
[0175]
[Equation 16]
deltaDshp <- (AFz - AF) /AF -- [Formula 16]
In addition, the maps used at steps S516 and S526 of fuel-injection-timing control processing (drawing 17) differ in the gestalt 1 of said operation, and serve as a content corresponding to having

used the air-fuel ratio AF.
[0176] In the gestalt 5 of operation mentioned above, steps S810-S840 of steps S450-S470 of Dshp detection processing (drawing 16), S490, and drawing 28 are [whenever / geometrical degradation] equivalent to the processing as a degradation degree detection means.
[0177] According to the gestalt 5 of this operation explained above, the following effectiveness is acquired.
(**) -- it asks for the lack degree "AFz-AF" which is the difference of the assumption air-fuel ratio AFz after amendment and the real air-fuel ratio AF which are obtained based on the assumption fuel-injection control input Qz after . amendment, and the inhalation air content Ga, and variation deltaDshp is calculated whenever [geometrical degradation] based on this value (S810-S840). And Dshp is computed [whenever / this geometrical degradation] from variation deltaDshp whenever [geometrical degradation / which is degradation degrees other than fuel oil consumption] (S490). Thus, Dshp can be calculated whenever [only showing degradation degrees other than fuel oil consumption / geometrical degradation].
[0178] The same effectiveness as (b) of the gestalt 1 of the (b) . aforementioned implementation and (d) is produced.
With the gestalt 6 of the [gestalt 6 of operation] book operation, processing of drawing 29 is performed whenever [geometrical degradation / of the gestalt 1 of said operation] instead of processing of step S480 of Dshp detection processing (drawing 16). Furthermore, with the gestalt 6 of this operation, the combustion pressure sensor is formed in the cylinder head 8. And the real mean effective pressure Pi shall be calculated in ECU from the combustion pressure in the combustion chamber 10 detected by the combustion pressure sensor. Especially other configurations are the same as the gestalt 1 of said operation, unless it explains.
[0179] In processing of drawing 29 , the assumption mean effective pressure Pz after amendment assumed based on the assumption fuel-injection control input Qz after amendment is first computed from the map shown in drawing 30 based on engine-speed NE, an intake pressure PM, and the assumption fuel-injection control input Qz after amendment (S910). This map asks for the real mean effective pressure Pi generated in the engine at the time of the idle in stratification combustion by making engine-speed NE, an intake pressure PM, and the fuel-injection control input Qz into a parameter by experiment beforehand, and is memorized in ROM of ECU.
[0180] Next, as shown in the degree type 17, variation deltaDshp is computed whenever [geometrical degradation] (S920).
[0181]
[Equation 17]
deltaDshp <- (Pi - Pz) /Pi -- [Formula 17]
In addition, the maps used at steps S516 and S526 differ in the gestalt 1 of said operation, and serve as a content corresponding to having used the real mean effective pressure Pi.
[0182] In the gestalt 6 of operation mentioned above, steps S910 and S920 of steps S450-S470 of Dshp detection processing (drawing 16), S490, and drawing 29 are [whenever / geometrical degradation] equivalent to the processing as a degradation degree detection means.
[0183] According to the gestalt 6 of this operation explained above, the following effectiveness is acquired.
(**) -- it asks for the lack degree "Pi-Pz" which is the difference of the . real mean effective pressure Pi and the assumption mean effective pressure Pz after amendment obtained based on the assumption fuel-injection control input Qz after amendment, and variation deltaDshp is calculated whenever [geometrical degradation] based on this value (S910, S920). And Dshp is computed [whenever / geometrical degradation] from variation deltaDshp whenever [geometrical degradation / which is degradation degrees other than fuel oil consumption] (S490). Thus, Dshp can be calculated whenever [only showing degradation degrees other than fuel oil consumption / geometrical degradation].
[0184] The same effectiveness as (b) of the gestalt 1 of the (b) . aforementioned implementation and (d) is produced.
With the gestalt 7 of the [gestalt 7 of operation] book operation, amendment assumption fuel-oil-consumption setting-out processing shown in fuel-oil-consumption control processing and drawing

32 instead of fuel-oil-consumption control processing (drawing 13) at the time of the stratification and weak stratification combustion shown in drawing 31 at the time of a stratification and weak stratification combustion of the gestalt 1 of said operation is performed. Furthermore, air-fuel ratio AFt detection processing corresponding to the amendment assumption fuel oil consumption shown in drawing 33 is performed. Moreover, Dshp detection processing is performed [whenever / geometrical degradation / of the gestalt 1 of said operation] whenever [geometrical degradation / of drawing 34] instead of Dshp detection processing (drawing 16). Moreover, the linear air-fuel ratio sensor is formed instead of the oxygen sensor 90. Especially other configurations are the same as the gestalt 1 of said operation, unless it explains.

[0185] Fuel-oil-consumption control processing (drawing 31) is explained at the time of a stratification and weak stratification combustion. In this processing, the following point differs from fuel-oil-consumption control processing (drawing 13) at the time of a stratification and weak stratification combustion of the gestalt 1 of said operation. Namely, after being judged with the time of an idle (it is "YES" at S210) When it is the processing (S1010) and the combustion gestalt R1 which judge whether it is the combustion gestalt R1, by (S1010 "YES"), amendment -- an assumption -- fuel injection -- activation -- completion -- a flag -- Fz -- "-- ON -- " -- ****** -- judging -- processing (S1020) -- Fz -- = -- "-- OFF -- " -- it was -- a case -- (-- S -- 1020 -- "-- NO -- " --) -- drawing 32 -- being shown -- amendment -- an assumption -- fuel oil consumption -- setting out -- processing (S1030) -- performing -- having -- a point -- differing . At the time of a stratification and weak stratification combustion, especially other processings of fuel-oil-consumption control processing (drawing 31) are the same as processing of fuel-oil-consumption control processing (drawing 13) at the time of a stratification and weak stratification combustion of the gestalt 1 of said operation, unless it explains, the same step number shows and detailed explanation is omitted.

[0186] Therefore, when it is the combustion gestalt R2 (weak stratification combustion), it shifts to processing of "NO") and step S220 in (S1010, and it becomes the same processing as the gestalt 1 of said operation. Moreover, if it is Fz= "ON" even if it is the case of the combustion gestalt R1 (stratification combustion) (it is "YES" at S1010) (it is "YES" at S1020), it will shift to processing of step S220, and will become the same processing as the gestalt 1 of said operation. However, if it is Fz= "OFF" (it is "NO" at S1020), although it is temporary, idle rpm feedback control (S220, S230) will not be performed, but amendment assumption fuel-oil-consumption setting-out processing (S1030) shown in drawing 32 will be performed.

[0187] This amendment assumption fuel-oil-consumption setting-out processing (drawing 32) is explained. First, as shown in the degree type 18, the assumption fuel-injection control input Qx is computed (S1110). This assumption fuel-injection control input Qx is equivalent to the fuel-injection control input set up when there is no degradation in a fuel injection valve 22.

[0188]

[Equation 18]

Qx <- Qorgs-qx -- [Formula 18]

Here, Qorgs is the same as the case of step S450 (drawing 16) of the gestalt 1 of said operation, and it is the fuel-injection control input memorized in the time of a start up after car loading of an engine 2 in the bottom of the same condition as this time.

[0189] Next, the amount Qvol of quantitative injection amendments is computed from the map shown in drawing 18 based on Dvol whenever [this assumption fuel-injection control input Qx and quantitative degradation / which is computed at step S370 of Dvol detection processing (drawing 15) whenever / quantitative degradation] (S1120). It seems that step S270 (drawing 13) of the gestalt 1 of said operation described the map of drawing 18 .

[0190] And using the amount Qvol of quantitative injection amendments and the assumption fuel-injection control input Qx which were computed by having carried out in this way, as shown in the degree type 19, the assumption fuel-injection control input Q after amendment is computed (S1130).

[0191]

[Equation 19]

Q <- Qx + Qvol -- [Formula 19]

Thus, the assumption fuel-injection control input Q after amendment calculated when the assumption fuel-injection control input Qx was amended by the amount Qvol of quantitative injection

amendments becomes what set the value as the real injection control input Q as it was supposing a fuel-injection control input when only degradation on fuel oil consumption arises. Fuel injection is made with the assumption fuel-injection control input Q after amendment by this, and it will burn in a combustion chamber 10.
[0192] And when the idle revolution is temporarily performed with the assumption fuel-injection control input Q after amendment in this way, the air-fuel ratio AFt corresponding to amendment assumption fuel oil consumption is detected by the air-fuel ratio AFt detection processing corresponding to the amendment assumption fuel oil consumption shown in drawing 33 . This air-fuel ratio AFt detection processing (drawing 33) corresponding to amendment assumption fuel oil consumption is performed the same period as fuel-oil-consumption control processing (drawing 10).
[0193] Initiation of the air-fuel ratio AFt detection processing (drawing 33) corresponding to amendment assumption fuel oil consumption judges first ****** at the time of the idle in the combustion gestalt R1 (S1210). If it is not at the idle time in the combustion gestalt R1 (it is "NO" at S1210), "OFF" will be set as the completion flag Fz of response air-fuel ratio AFt detection (S1220), and this processing will once be ended.
[0194] If it is at the idle time in the combustion gestalt R1 (it is "YES" at S1210) next, it will be judged for the completion flag Fz of response air-fuel ratio AFt detection whether it is "OFF" (S1230). If it is Fz= "ON" (it is "NO" at S1230), this processing will once be ended.
[0195] If it is Fz= "OFF" (it is "YES" at S1230) next, it will be judged whether the air-fuel ratio detection value VAF acquired from the output of a linear air-fuel ratio sensor was stable (S1240). For example, it judges between the conventional times by whether there is any fluctuation of the air-fuel ratio detection value VAF within small limits. If the air-fuel ratio detection value VAF is not stable (it is "NO" at S1240), this processing is once ended as it is.
[0196] If the air-fuel ratio detection value VAF is stable (it is "YES" at S1240) next, it will ask for a real air-fuel ratio by calculating with the relation fv as shown by drawing 23 based on the air-fuel ratio detection value VAF, and it will be set up as a response air-fuel ratio AFt (S1250).
[0197] And "ON" is set as the completion flag Fz of response air-fuel ratio AFt detection (S1260), and this processing is once ended. Dshp detection processing (drawing 34) is explained whenever [geometrical degradation]. In this processing, the same step number shows the same processing as Dshp detection processing (drawing 16) whenever [geometrical degradation / of the gestalt 1 of said operation].
[0198] If Dshp detection processing (drawing 34) is started whenever [geometrical degradation], it will be first judged for the completion flag Fz of response air-fuel ratio AFt detection whether it is "ON" (S1310). If it is Fz= "OFF" (it is "NO" at S1310), whenever [geometrical degradation], the completion flag Fx of Dshp detection will be set as "OFF" (S420), and will once end this processing.

[0199] If it is Fz= "ON" (i.e., if the response air-fuel ratio AFt is called for at said step S1250) (it is "NO" at S1310), ****** at the time of the idle in the combustion gestalt R1 will be judged next (S410). If it is not at the idle time in the combustion gestalt R1 (it is "NO" at S410), "OFF" will be set as the completion flag Fx of Dshp detection whenever [geometrical degradation] (S420), and this processing will once be ended.
[0200] If it is at the idle time in the combustion gestalt R1 (it is "YES" at S410) next, it will be judged for the completion flag Fx of Dshp detection whenever [geometrical degradation] whether it is "OFF" (S430). If it is Fx= "ON" (it is "NO" at S430), this processing will once be ended.
[0201] If it is Fx= "OFF" (it is "YES" at S430) next, it will be judged whether the engine speed NE was stable at the target rotational frequency NT (S440). If the engine speed NE is not stable at the target rotational frequency NT (it is "NO" at S440), this processing is once ended as it is.
[0202] If an engine speed NE is stable at the target rotational frequency NT (it is "YES" at S440) next, it will ask by calculating with the relation fv as showed the real air-fuel ratio AF by drawing 23 based on the air-fuel ratio detection value VAF by the linear air-fuel ratio sensor (S1320).
[0203] Next, as shown in the degree type 20, variation deltaDshp is computed whenever [geometrical degradation] (S1330).
[0204]

[Equation 20]
deltaDshp <- (AFt - AF) /AF -- [Formula 20]
Next, Dshp is computed whenever [geometrical degradation] like the degree type 21 (S490).
[0205]
[Equation 21]
Dshp <- Dshp + deltaDshp -- [Formula 21]
Next, "ON" is set as the completion flag Fx of Dshp detection whenever [geometrical degradation] (S500), and it once comes out of this processing.
[0206] In addition, since Dshp is calculated based on the air-fuel ratio whenever [geometrical degradation], the maps used at steps S516 and S526 of fuel-injection-timing control processing (drawing 17) differ in the gestalt 1 of said operation, and serve as a content corresponding to having used the air-fuel ratio.
[0207] In the configuration of the gestalt 7 of this operation, processing of drawing 32 and drawing 33 and steps S1320, S1330, and S490 of drawing 34 are equivalent to the processing as a degradation degree detection means.
[0208] According to the gestalt 7 of this operation explained above, the following effectiveness is acquired.
(**) -- based on the difference with the real air-fuel ratio (response air-fuel ratio AFt) at the time of carrying out fuel injection based on the assumption fuel-injection control input Q amended in the real air-fuel ratio AF at the time of maintaining an idle target rotational frequency, and the amount Qvol of quantitative injection amendments at the time of the idle in . stratification combustion, variation deltaDshp is calculated whenever [geometrical degradation] (S1330). And Dshp is computed [whenever / geometrical degradation] from variation deltaDshp whenever [geometrical degradation / which is degradation degrees other than fuel oil consumption] (S490). Thus, Dshp can be calculated whenever [geometrical degradation / which expresses only degradation degrees other than fuel oil consumption by the comparison of a real air-fuel ratio].
[0209] The same effectiveness as (b) of the gestalt 1 of the (b) . aforementioned implementation and (d) is produced.
With the gestalt 8 of the [gestalt 8 of operation] book operation, combustion pressure Ptt detection processing corresponding to the amendment assumption fuel oil consumption shown in drawing 35 is performed instead of the air-fuel ratio AFt detection processing (drawing 33) corresponding to amendment assumption fuel oil consumption of the gestalt 7 of said operation. Moreover, processing shown in drawing 36 is performed whenever [geometrical degradation / of the gestalt 7 of said operation] instead of steps S1320 and S1330 of Dshp detection processing (drawing 34). Furthermore, with the gestalt 8 of this operation, the combustion pressure sensor is formed in the cylinder head 8. And the real mean effective pressure Pi shall be calculated in ECU from the combustion pressure in the combustion chamber 10 detected by the combustion pressure sensor. Especially other configurations are the same as the gestalt 7 of said operation, unless it explains.
[0210] The combustion pressure Ptt detection processing (drawing 35) corresponding to amendment assumption fuel oil consumption is explained. Initiation of this processing judges first ****** at the time of the idle in the combustion gestalt R1 (S1410). If it is not at the idle time in the combustion gestalt R1 (it is "NO" at S1410), "OFF" will be set as the completion flag Fz of response combustion pressure Ptt detection (S1420), and this processing will once be ended.
[0211] If it is at the idle time in the combustion gestalt R1 (it is "YES" at S1410) next, it will be judged for the completion flag Fz of response combustion pressure Ptt detection whether it is "OFF" (S1430). If it is Fz= "ON" (it is "NO" at S1430), this processing will once be ended.
[0212] If it is Fz= "OFF" (it is "YES" at S1430) next, it will be judged whether the real mean effective pressure Pi was stable (S1440). For example, it judges between the conventional times by whether there is any fluctuation of the real mean effective pressure Pi within small limits. If the real mean effective pressure Pi is not stable (it is "NO" at S1440), this processing is once ended as it is.
[0213] If the real mean effective pressure Pi is stable (it is "YES" at S1440) next, the real mean effective pressure Pi will be set up as response combustion pressure Ptt (S1450). And "ON" is set as the completion flag Fz of response combustion pressure Ptt detection (S1460), and this processing is once ended.

[0214] Whenever [geometrical degradation / which is performed based on the processing mentioned above], about Dshp detection processing, when an engine speed NE is stable at the target rotational frequency NT (it is "YES" at S440), processing as shown in drawing 36 is performed.
[0215] That is, as shown in the degree type 22, based on the response combustion pressure Ptt and the current real mean effective pressure Pi, variation deltaDshp is computed whenever [geometrical degradation] (S1510).
[0216]
[Equation 22]
deltaDshp <- (Pi - Ptt) /Pi -- [Formula 22]
In this way, next, as mentioned above at step S490, Dshp is computed whenever [geometrical degradation].
[0217] In addition, since Dshp is calculated based on mean effective pressure whenever [geometrical degradation], the maps used at steps S516 and S526 of fuel-injection-timing control processing (drawing 17) differ in the gestalt 7 of said operation, and serve as a content corresponding to having used mean effective pressure.
[0218] According to the gestalt 8 of this operation explained above, the following effectiveness is acquired.
(**) -- based on the difference of the real mean effective pressure Pi at the time of maintaining an idle target rotational frequency, and the response combustion pressure Ptt at the time of carrying out fuel injection based on the assumption fuel-injection control input Q amended in the amount Qvol of quantitative injection amendments, variation deltaDshp is calculated whenever [geometrical degradation] at the time of the idle in . stratification combustion (S1510). And Dshp is computed [whenever / geometrical degradation] from variation deltaDshp whenever [geometrical degradation / which is degradation degrees other than fuel oil consumption] (S490). Thus, Dshp can be calculated whenever [geometrical degradation / which expresses only degradation degrees other than fuel oil consumption by the comparison of real mean effective pressure].
[0219] The same effectiveness as (b) of the gestalt 1 of the (b) . aforementioned implementation and (d) is produced.
With the gestalt 9 of the [gestalt 9 of operation] book operation, Dshp detection processing is performed [whenever / geometrical degradation] instead of Dshp detection processing (drawing 16) in the configuration of the gestalt 1 of said operation whenever [geometrical degradation / which is shown in drawing 37]. Moreover, the linear air-fuel ratio sensor is formed instead of the oxygen sensor 90. Especially other configurations are the same as the gestalt 1 of said operation, unless it explains.
[0220] If Dshp detection processing is started whenever [geometrical degradation], ****** at the time of the idle in the combustion gestalt R1 will be judged first (S1610). If it is not at the idle time in the combustion gestalt R1 (it is "NO" at S1610), "OFF" will be set as the completion flag Fx of Dshp detection whenever [geometrical degradation] (S1620), "OFF" will be set as the Air Fuel Ratio Control completion flag Faf (S1630), and this processing will once be ended.
[0221] If it is at the idle time in the combustion gestalt R1 (it is "YES" at S1610) next, it will be judged for the completion flag Fx of Dshp detection whenever [geometrical degradation] whether it is "OFF" (S1640). If it is Fx= "ON" (it is "NO" at S1640), "OFF" will be set as the Air Fuel Ratio Control completion flag Faf, and this processing will once (S1630) be ended.
[0222] If it is Fx= "OFF" (it is "YES" at S1640) next, it will be judged for the Air Fuel Ratio Control completion flag Faf whether it is "ON" (S1650). If it is Faf= "OFF" (it is "NO" at S1650), engine-speed feedback control will be forbidden next (S1660). Calculation processing of the real fuel-injection control input Q by steps S220 and S230 of fuel-oil-consumption control processing (drawing 13) is suspended by this at the time of a stratification and weak stratification combustion.
[0223] And in order to control the current air-fuel ratio AF to the initial idle air-fuel ratio AFst at the time of stratification combustion, difference deltaAF with the initial idle air-fuel ratio AFst is computed like a degree type at the time of the air-fuel ratio AF detected by current and the linear air-fuel ratio sensor, and stratification combustion (S1670).
[0224]
[Equation 23]

deltaAF <- AF - AFst -- [Formula 23]
Here, the initial idle air-fuel ratio AFst is an air-fuel ratio memorized under the same condition as this time in the time of a start up after car loading of an engine 2 at the time of stratification combustion. That is, in the time of a start up after car loading of an engine 2, it is the value which memorized the air-fuel ratio at the time of attaining the same target idle rpm NT at the time of the idle in stratification combustion (combustion gestalt R1) to backup RAM60e.
[0225] Next, according to air-fuel ratio difference deltaAF, the real fuel-injection control input Q for controlling an air-fuel ratio AF to the initial idle air-fuel ratio AFst at the time of stratification combustion is computed by the feedback count fa (S1680). Thus, as an air-fuel ratio AF turns into the initial idle air-fuel ratio AFst with the calculated real fuel-injection control input Q at the time of stratification combustion, feed back control of air-fuel ratio is made.
[0226] Next, it is judged whether the air-fuel ratio AF is stable with the initial idle air-fuel ratio AFst at the time of stratification combustion (S1690). For example, it judges between the conventional times by whether the air-fuel ratio AF exists by criteria within the limits to the initial idle air-fuel ratio AFst at the time of stratification combustion. If the air-fuel ratio AF is not stable with the initial idle air-fuel ratio AFst at the time of stratification combustion (it is "NO" at S1690), this processing is once ended as it is.
[0227] If an air-fuel ratio AF is stable with the initial idle air-fuel ratio AFst at the time of stratification combustion (it is "YES" at S1690), the real fuel-injection control input Q at this time will be set up as an initial air-fuel ratio achievement fuel-injection control input Qf (S1700). And "ON" is set as the Air Fuel Ratio Control completion flag Faf (S1710), and this processing is once ended.
[0228] The following control period, since it became Faf= "ON", at step S1650, it is judged with "YES." It follows, next engine-speed feedback control is permitted (S1720). By this, processing of the real fuel-injection control input Q by steps S220 and S230 of fuel-oil-consumption control processing (drawing 13) returns at the time of a stratification and weak stratification combustion, and idle rpm feedback control by the increase and decrease of amendment of the real fuel-injection control input Q is performed.
[0229] Next, it is judged whether the engine speed NE is stable at the target rotational frequency NT (S1730). For example, it judges between the conventional times by whether the engine speed NE exists by criteria within the limits to the target rotational frequency NT. If the engine speed NE is not stable at the target rotational frequency NT (it is "NO" at S1730), this processing is once ended as it is.
[0230] If the engine speed NE is stable at the target rotational frequency NT (it is "YES" at S1730) next, as shown in the degree type 24, variation deltaDshp will be computed whenever [geometrical degradation] (S1740).
[0231]
[Equation 24]
deltaDshp <- (Q - Qf) /Q -- [Formula 24]
This formula 24 expresses change of the inflammable aggravation degree by factors, such as a fuel-injection configuration, called the direction of the change of whenever [of those other than fuel oil consumption / degradation] from a fuel injection valve 22 to into a combustion chamber 10, for example, fuel injection, and breadth of fuel Myst in the fuel injection valve 22. The fuel-injection control input Q is the real fuel-injection control input Q computed by feedback count of step S230 of fuel-oil-consumption control processing (drawing 13) at the time of a stratification and weak stratification combustion.
[0232] Next, Dshp is computed whenever [geometrical degradation] like the degree type 25 (S1750).
[0233]
[Equation 25]
Dshp <- Dshp + deltaDshp -- [Formula 25]
As for the initial value of Dshp, "0" is set up whenever [in the beginning when the engine 2 was carried in the car / geometrical degradation]. Therefore, when step S1750 is performed first, deltaDshp, i.e., "/(Q - Qf) Q", is set to Dshp whenever [geometrical degradation]. And from the 2nd

time, the amendment for variation deltaDshp to have arisen whenever [geometrical degradation] will be made by said formula 25 to Dshp whenever [geometrical degradation].
[0234] Next, "ON" is set as the completion flag Fx of Dshp detection whenever [geometrical degradation] (S1760), and it once comes out of this processing. According to the gestalt 9 of this operation explained above, the following effectiveness is acquired.
[0235] The initial air-fuel ratio achievement fuel-injection control input Qf which was adjusted and was obtained so that it might become the initial idle air-fuel ratio AFst at the time of (b) . stratification combustion is the same as the assumption fuel-injection control input Qz after amendment amended and obtained in the amount Qvol of quantitative injection amendments in the gestalt 1 of said operation. For this reason, in order to obtain Dshp whenever [geometrical degradation], it is not necessary to calculate Dvol and the amount Qvol of quantitative injection amendments whenever [quantitative degradation], and Dshp can be obtained whenever [geometrical degradation] with a simpler configuration.
[0236] The effectiveness of (d) of the gestalt 1 of the (b) . aforementioned implementation is produced.
With the gestalt 10 of the [gestalt 10 of operation] book operation, Dshp detection processing is performed [whenever / geometrical degradation] instead of Dshp detection processing (drawing 37) in the configuration of the gestalt 9 of said operation whenever [geometrical degradation / which is shown in drawing 38]. Especially other configurations are the same as the gestalt 9 of said operation, unless it explains.
[0237] If Dshp detection processing is started whenever [geometrical degradation], ****** at the time of the idle in the combustion gestalt R1 will be judged first (S1810). If it is not at the idle time in the combustion gestalt R1 (it is "NO" at S1810), "OFF" will be set as the completion flag Fx of Dshp detection whenever [geometrical degradation] (S1820), and this processing will once be ended.
[0238] If it is at the idle time in the combustion gestalt R1 (it is "YES" at S1810) next, it will be judged for the completion flag Fx of Dshp detection whenever [geometrical degradation] whether it is "OFF" (S1830). If it is Fx= "ON" (it is "NO" at S1830), this processing will once be ended.
[0239] If it is Fx= "OFF" (it is "YES" at S1830) next, it will be judged whether the engine speed NE is stable at the target rotational frequency NT (S1840). It seems that the gestalt 9 of said operation described stabilization of an engine speed NE. If the engine speed NE is not stable at the target rotational frequency NT (it is "NO" at S1840), this processing is once ended as it is.
[0240] If the engine speed NE is stable at the target rotational frequency NT (it is "YES" at S1840) next, as shown in the degree type 26, variation deltaDshp will be computed whenever [geometrical degradation] (S1850).
[0241]
[Equation 26]
deltaDshp <- (AFst - AF) /AF -- [Formula 26]
This formula 26 expresses change of the inflammable aggravation degree by factors, such as a fuel-injection configuration, called the direction of the change of whenever [of those other than fuel oil consumption / degradation] from a fuel injection valve 22 to into a combustion chamber 10, for example, fuel injection, and breadth of fuel Myst in the fuel injection valve 22. The fuel-injection control input AFst is the air-fuel ratio memorized under the same condition as this time in the time of a start up after car loading of an engine 2. That is, in the time of a start up after car loading of an engine 2, it is the value which memorized the air-fuel ratio at the time of attaining the same target idle rpm NT at the time of the idle in stratification combustion (combustion gestalt R1) to backup RAM60e. Moreover, the air-fuel ratio AF expresses the current air-fuel ratio detected by the linear air-fuel ratio sensor.
[0242] Next, Dshp is computed whenever [geometrical degradation] like the degree type 27 (S1860).
[0243]
[Equation 27]
Dshp <- Dshp + deltaDshp -- [Formula 27]
As for the initial value of Dshp, "0" is set up whenever [in the beginning when the engine 2 was

carried in the car / geometrical degradation]. Therefore, when step S1860 is performed first, deltaDshp, i.e., "/(AFst -AF) AF", is set to Dshp whenever [geometrical degradation]. And from the 2nd time, the amendment for variation deltaDshp to have arisen whenever [geometrical degradation] will be made by said formula 27 to Dshp whenever [geometrical degradation].
[0244] Next, "ON" is set as the completion flag Fx of Dshp detection whenever [geometrical degradation] (S1870), and it once comes out of this processing. According to the gestalt 10 of this operation explained above, the following effectiveness is acquired.
[0245] Regardless of quantitative degradation of a fuel injection valve 22, only geometrical degradation is related to difference deltaAF with the air-fuel ratio AF for attaining a target rotational frequency in the initial idle air-fuel ratio AFst and this time at the time of (b) . stratification combustion. For this reason, in order to obtain Dshp whenever [geometrical degradation], it is not necessary to calculate Dvol and the amount Qvol of quantitative injection amendments whenever [quantitative degradation], and Dshp can be obtained whenever [geometrical degradation] with a simpler configuration.
[0246] The effectiveness of (d) of the gestalt 1 of the (b) . aforementioned implementation is produced.
[The gestalt of other operations]
- By computing Dshp whenever [geometrical degradation] only with the combustion gestalt R1 (stratification combustion) in Dshp detection processing, by weak stratification combustion (combustion gestalt R2), although Dshp did not compute, it may compute [whenever / geometrical degradation / of the gestalt of each aforementioned implementation / whenever / geometrical degradation] Dshp whenever [geometrical degradation] by being based on the fuel quantity injected by the compression stroke last stage among the fuel-injection control inputs Q at the time of weak stratification combustion.
[0247] - In the gestalten 1-8 of the aforementioned implementation, the assumption fuel-injection control input was amended in Dvol whenever [quantitative degradation] at the time of stratification combustion, it is searching for the difference of the study value acquired the assumption fuel-injection control input after this amendment, or from now on, an air-fuel ratio, combustion pressure, and the study value acquired a real fuel-injection control input or from now on, an air-fuel ratio and combustion pressure, and Dshp was calculated whenever [geometrical degradation]. By searching for the difference of the study value acquired the assumption fuel-injection control input which has not been amended at the time of stratification combustion, or from now on, an air-fuel ratio, combustion pressure, and the study value acquired a real fuel-injection control input or from now on, an air-fuel ratio and combustion pressure in addition to this You may make it calculate Dshp whenever [geometrical degradation] by detecting the value of "being [whenever / geometrical degradation] Dvol whenever [Dshp+ quantitative degradation]", and subtracting Dvol from this value whenever [quantitative degradation].
[0248] - In the gestalten 2-4 of the aforementioned implementation, although Dshp was calculated whenever [geometrical degradation] based on the difference of the assumption fuel-injection control input after amendment, and a real fuel-injection control input, also in the gestalten 2-4 of said operation, Dshp may be calculated whenever [geometrical degradation] by technique as shown in the gestalten 5-8 of said operation.
[0249] - Although mean effective pressure was used with the gestalten 4, 6, and 8 of the aforementioned implementation, the highest combustion pressure may be used in addition to this.
- although fuel injection timing was amended with the gestalt of said the operation of each based on Dshp whenever [geometrical degradation / for which it asked] -- this -- changing -- or -- in addition, you may make it amend ignition timing based on Dshp whenever [geometrical degradation] Moreover, you may make it Dvol also amend [whenever / geometrical degradation] such fuel-injection-timing amendment or ignition-timing amendment whenever [quantitative degradation] with Dshp.
[0250] - In the gestalt of each aforementioned implementation, since it will become easy to carry out a flame failure by EGR if Dshp becomes large whenever [geometrical degradation] when EGR (exhaust gas recirculation) control is being performed, according to the increment in Dshp, it may be made to make the amount of EGR(s) small whenever [geometrical degradation]. You may make it

Dvol also amend [whenever / geometrical degradation] the amount of EGR(s) whenever [quantitative degradation] with Dshp also in this case.
[0251] - Although Dshp was amended [whenever / geometrical degradation / whenever / geometrical degradation] as it was in variation deltaDshp whenever [geometrical degradation] at the time of calculation of Dshp, you may make it add what carried out reduction amendment with the multiplier k (0< k<1) in the gestalt of each aforementioned implementation, for example, as shown in the degree type 28.
[0252]
[Equation 28]
Dshp <- Dshp + K-delta Dshp -- [Formula 28]
- Or instead of amending [whenever / geometrical degradation] Dshp as it is in variation deltaDshp whenever [geometrical degradation], when deltaDshp becomes larger than a reference value, Dshp may be amended [whenever / geometrical degradation] in variation deltaDshp whenever [geometrical degradation] for the first time. Furthermore, when deltaDshp becomes larger than a reference value, you may amend like said formula 28.
[0253] - With the gestalt of each aforementioned implementation, after calculating variation deltaDshp whenever [geometrical degradation], Dshp was once computed whenever [new geometrical degradation] by amending [whenever / geometrical degradation] Dshp in variation deltaDshp whenever [geometrical degradation]. You may make it be a degree in addition to this. That is, in case the completion flag Fx of Dshp detection is "ON" whenever [geometrical degradation], the ignition-timing amendment by Dshp is suspended [whenever / geometrical degradation] whenever [fuel-injection-timing amendment / by Dshp / (drawing 17 : S516, S518), or geometrical degradation]. And Dshp is calculated whenever [geometrical degradation] directly, without performing count of variation deltaDshp whenever [geometrical degradation]. For example, it becomes being in the case of the gestalt 1 of said operation like the degree type 29.
[0254]
[Equation 29]
Dshp <- (Q - Qz) /Q -- [Formula 29]

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The outline block diagram of a cylinder-injection-of-fuel type internal combustion engine in the gestalt 1 of operation.
[Drawing 2] The block diagram of the cylinder-injection-of-fuel type internal combustion engine control system of the gestalt 1 of operation.
[Drawing 3] The horizontal sectional view of the cylinder head in the gestalt 1 of operation.
[Drawing 4] The top view of the top face in the piston of the gestalt 1 of operation.
[Drawing 5] The X-X sectional view in drawing 3 .
[Drawing 6] The Y-Y sectional view in drawing 3 .
[Drawing 7] The flow chart of combustion gestalt setting-out processing of the gestalt 1 of operation.

[Drawing 8] The map configuration explanatory view for calculating the Lean fuel oil consumption QL with the gestalt 1 of operation.
[Drawing 9] The map configuration explanatory view for setting up a combustion gestalt with the gestalt 1 of operation.
[Drawing 10] The flow chart of fuel-oil-consumption control processing of the gestalt 1 of operation.

[Drawing 11] The map configuration explanatory view for calculating the theoretical-air-fuel-ratio basic fuel oil consumption QBS with the gestalt 1 of operation.
[Drawing 12] The flow chart of heavy load loading OTP calculation processing of the gestalt 1 of operation.
[Drawing 13] It is the flow chart of fuel-oil-consumption control processing at the time of a stratification and weak stratification combustion of the gestalt 1 of operation.
[Drawing 14] The map configuration explanatory view for asking for the assumption fuel-injection control input lowering multiplier qx based on the operation addition time amount Texe with the gestalt 1 of operation.
[Drawing 15] It is the flow chart of Dvol detection processing whenever [quantitative degradation / of the gestalt 1 of operation].
[Drawing 16] It is the flow chart of Dshp detection processing whenever [geometrical degradation / of the gestalt 1 of operation].
[Drawing 17] The flow chart of fuel-injection-timing control processing of the gestalt 1 of operation.

[Drawing 18] The map configuration explanatory view for calculating the amount Qvol of quantitative injection amendments based on Dvol whenever [fuel-injection control input and quantitative degradation] with the gestalt 1 of operation.
[Drawing 19] The map configuration explanatory view for asking for the fuel injection timing Ainj for a stratification based on an engine speed NE and the real fuel-injection control input Q with the gestalt 1 of operation.
[Drawing 20] The map configuration explanatory view for asking for the fuel injection timing Finj for homogeneity based on an engine speed NE and the real fuel-injection control input Q with the gestalt 1 of operation.
[Drawing 21] It is the flow chart of Dvol detection processing whenever [quantitative degradation /

of the gestalt 2 of operation].
[Drawing 22] The graph which shows the output of the current signal I according to the air-fuel ratio in the linear air-fuel ratio sensor of the gestalt 3 of operation.
[Drawing 23] The graph which shows the case where the output of the current signal I of the linear air-fuel ratio sensor of the gestalt 3 of operation is changed into a voltage signal VAF.
[Drawing 24] It is the flow chart of Dvol detection processing whenever [quantitative degradation / of the gestalt 3 of operation].
[Drawing 25] The map configuration explanatory view for calculating the inhalation air content Ga based on an engine speed NE and an intake pressure PM with the gestalt 3 of operation.
[Drawing 26] It is the flow chart of Dvol detection processing whenever [quantitative degradation / of the gestalt 4 of operation].
[Drawing 27] The map configuration explanatory view for asking for the assumption mean effective pressure P based on engine-speed NE, an intake pressure PM, and the real fuel-injection control input Q with the gestalt 4 of operation.
[Drawing 28] The flow chart which shows a part of Dshp detection processing whenever [geometrical degradation / of the gestalt 5 of operation].
[Drawing 29] The flow chart which shows a part of Dshp detection processing whenever [geometrical degradation / of the gestalt 6 of operation].
[Drawing 30] The map configuration explanatory view for asking after [amendment] assumption mean-effective-pressure Pz based on engine-speed NE, an intake pressure PM, and the assumption fuel-injection control input Qz after amendment with the gestalt 6 of operation.
[Drawing 31] It is the flow chart of fuel-oil-consumption control processing at the time of a stratification and weak stratification combustion of the gestalt 7 of operation.
[Drawing 32] The flow chart of amendment assumption fuel-oil-consumption setting-out processing of the gestalt 7 of operation.
[Drawing 33] The flow chart of the air-fuel ratio AFt detection processing corresponding to amendment assumption fuel oil consumption of the gestalt 7 of operation.
[Drawing 34] The flow chart which shows Dshp detection processing whenever [geometrical degradation / of the gestalt 7 of operation].
[Drawing 35] The flow chart of the combustion pressure Ptt detection processing corresponding to amendment assumption fuel oil consumption of the gestalt 8 of operation.
[Drawing 36] The flow chart which shows a part of Dshp detection processing whenever [geometrical degradation / of the gestalt 8 of operation].
[Drawing 37] The flow chart which shows Dshp detection processing whenever [geometrical degradation / of the gestalt 9 of operation].
[Drawing 38] The flow chart which shows Dshp detection processing whenever [geometrical degradation / of the gestalt 10 of operation].
[Description of Notations]
2 [-- Piston,] -- An engine, 2a -- A cylinder, 4 -- A cylinder block, 6 8 [-- The 2nd inlet valve,] -- The cylinder head, 10 -- A combustion chamber, 12a -- The 1st inlet valve, 12b 14a -- The 1st inlet port, 14b -- The 2nd inlet port, 16 -- Exhaust valve, 18 [-- Crevice,] -- An exhaust port, 20 -- An ignition plug, 22 -- A fuel injection valve, 24 26 [-- The 2nd inhalation-of-air path,] -- A circumferential wall surface, 30 -- An inlet manifold, 30a -- The 1st inhalation-of-air path, 30b 32 -- A surge tank, 34 -- An air-current control valve, 36 -- A shaft, 37 -- Negative pressure type actuator, 40 [-- Throttle valve,] -- An air intake duct, 42 -- An air cleaner, 44 -- A motor, 46 46a -- A throttle opening sensor, 48 -- An exhaust manifold, 49 -- Catalytic converter, a 50a-- fuel-pressure sensor and 55 -- electromagnetism -- a spill valve, 60 --ECU, and a 60a-- bi-directional bus -- 60 b--CPU, 60 c--ROM, 60d -- RAM, 60e -- Backup RAM 60f [-- Accelerator opening sensor,] -- An input circuit, 60g -- An output circuit, 74 -- An accelerator pedal, 76 82 [-- An intake-pressure sensor, 90 / -- An oxygen sensor, 92 / -- A dc-battery, 94 / -- A speed sensor, 100 -- / An ignitor, 102 -- Starter motor.] -- A rotational frequency sensor, 84 -- A cylinder distinction sensor, 86 -- A coolant temperature sensor, 88

[Translation done.]

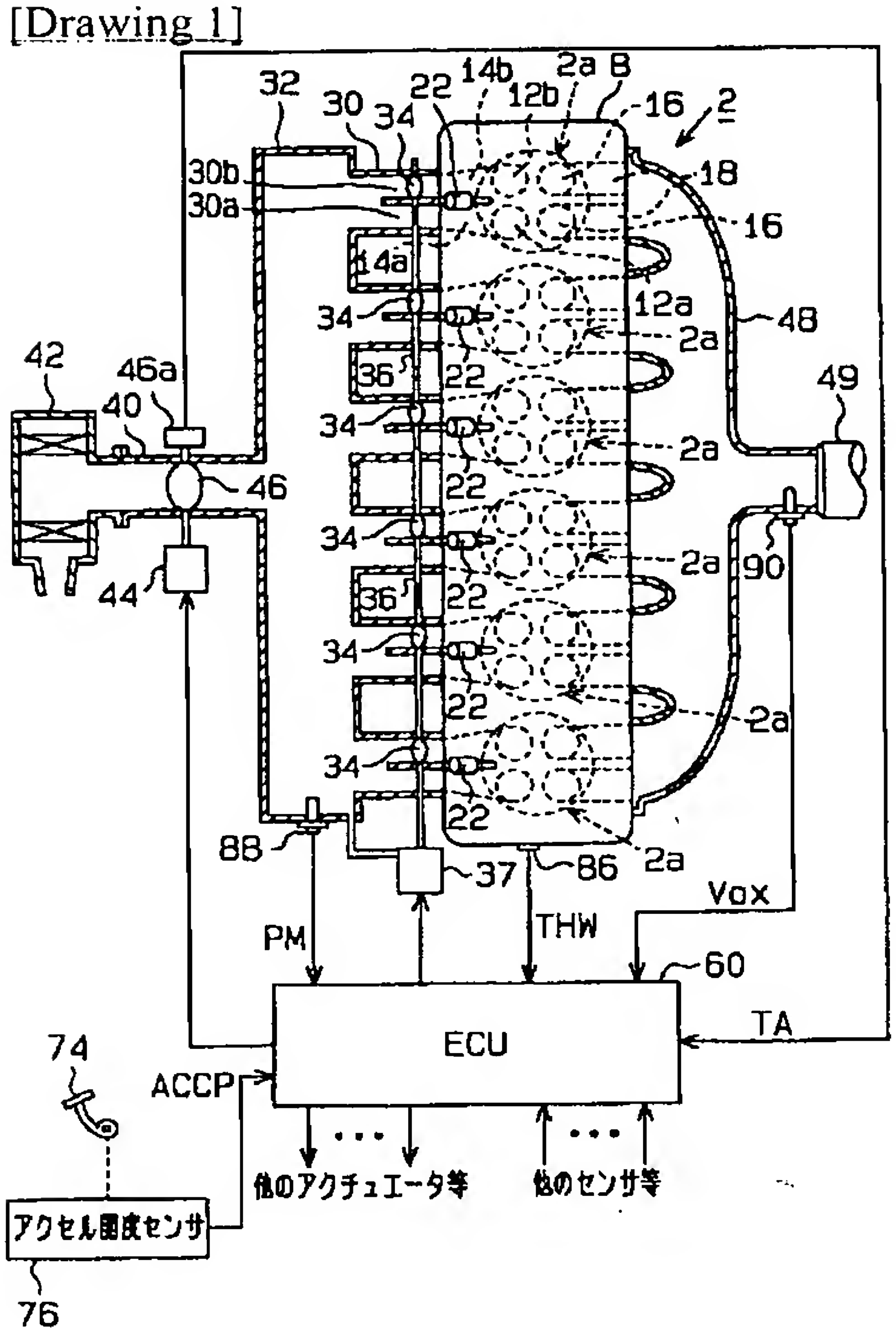
* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

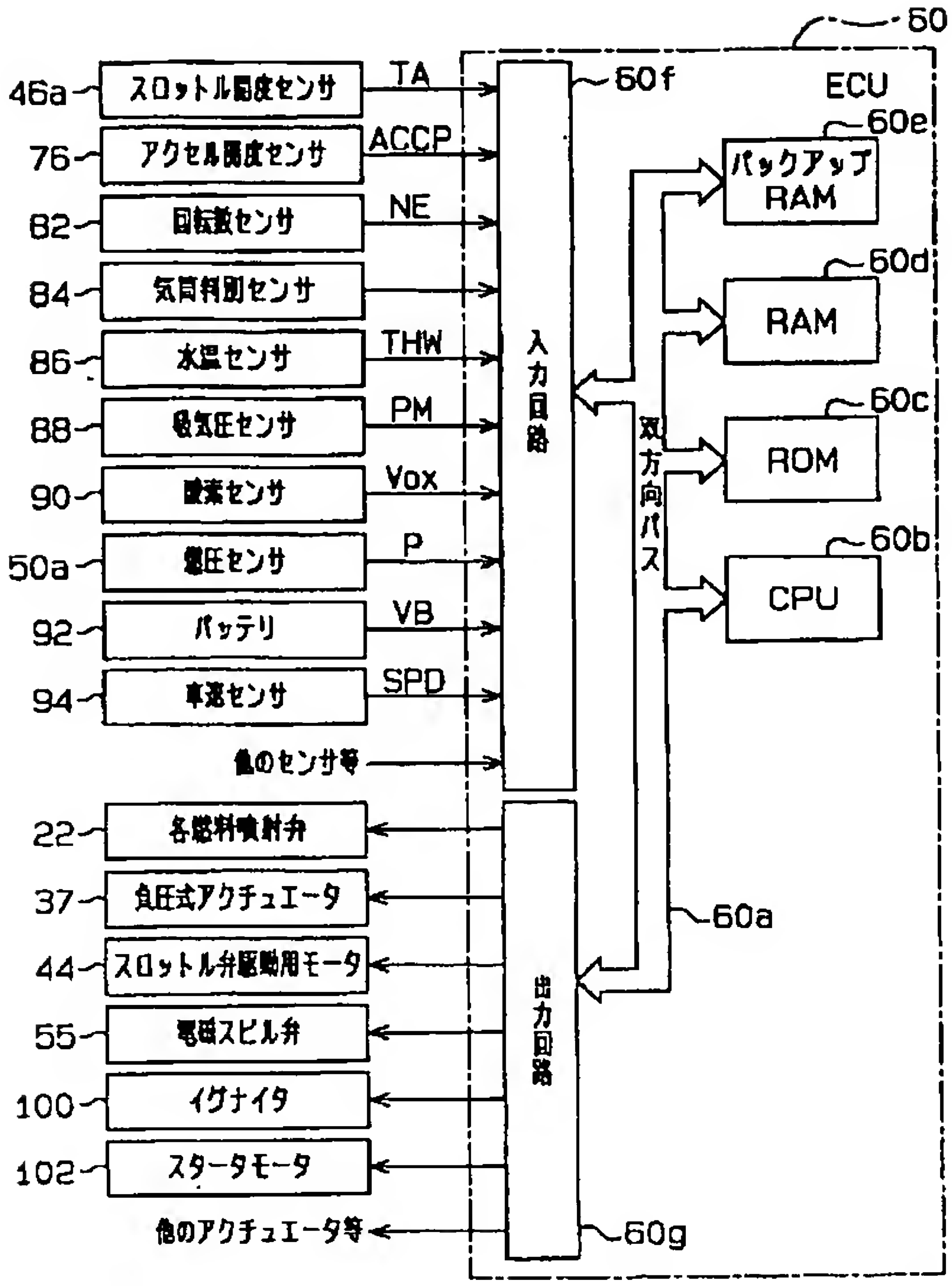
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

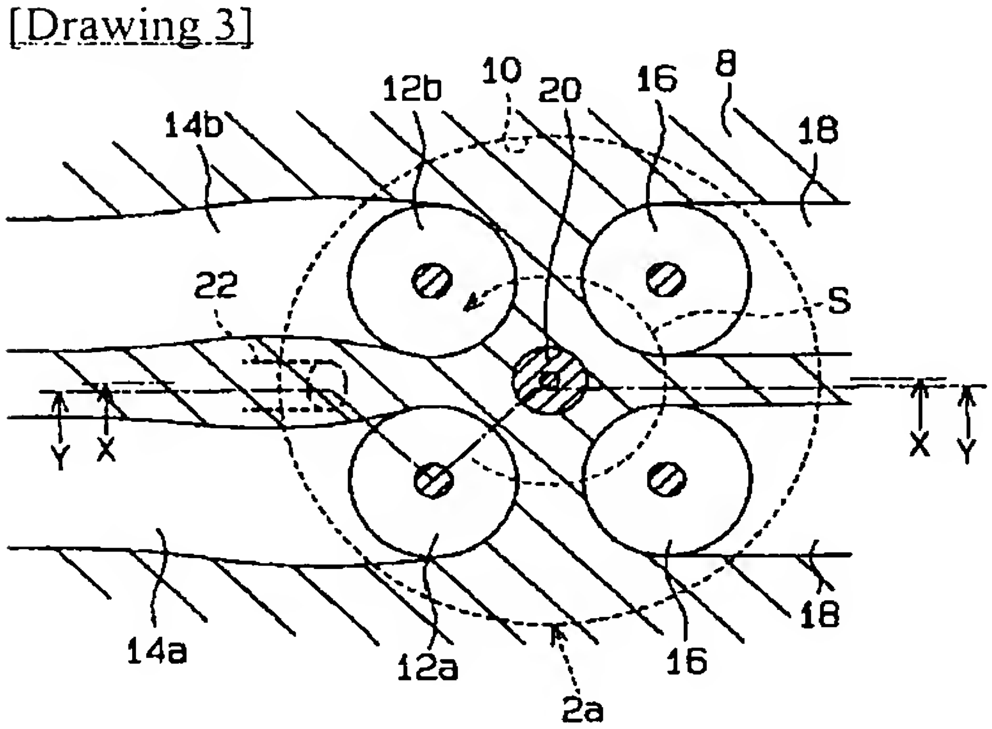
[Drawing 1]



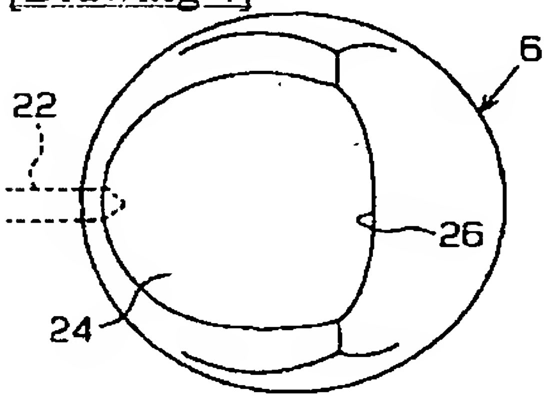
[Drawing 2]



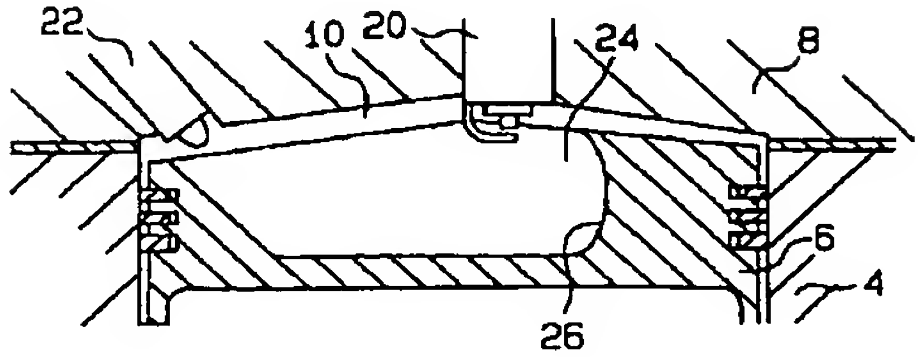
[Drawing 3]



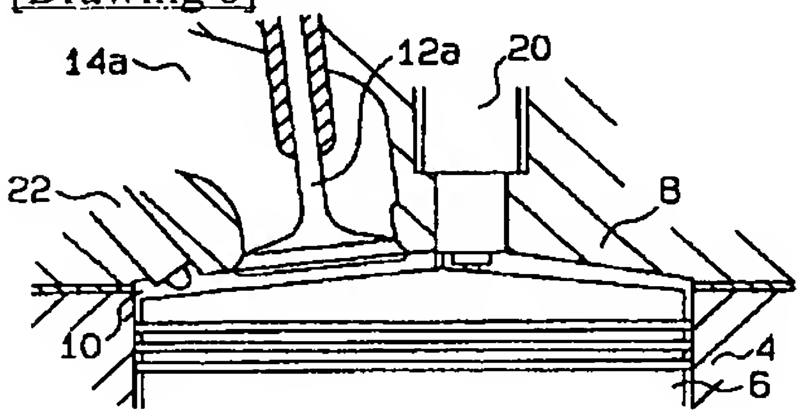
[Drawing 4]



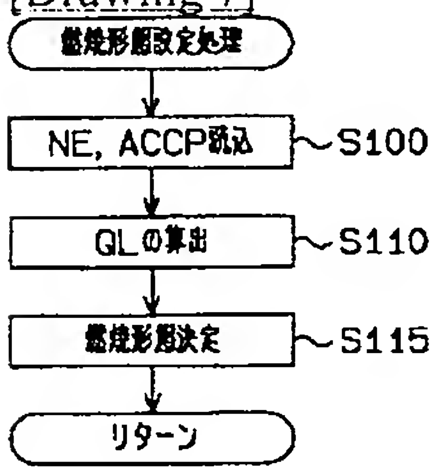
[Drawing 5]



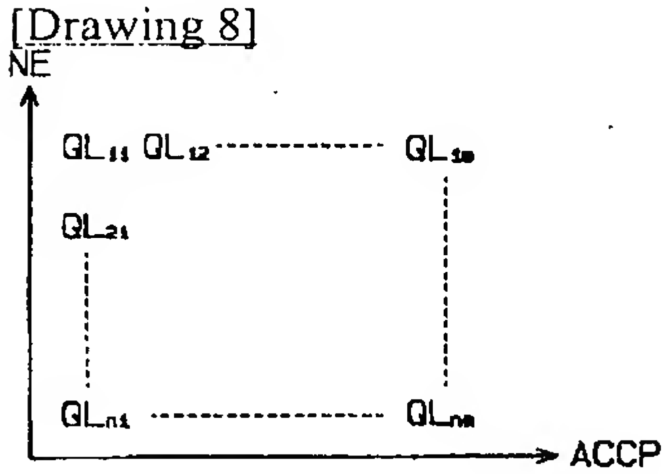
[Drawing 6]



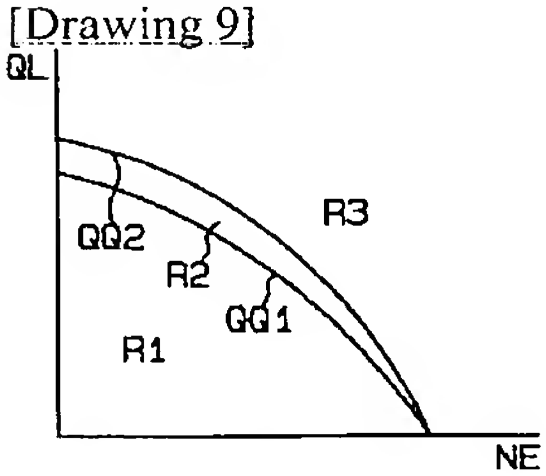
[Drawing 7]



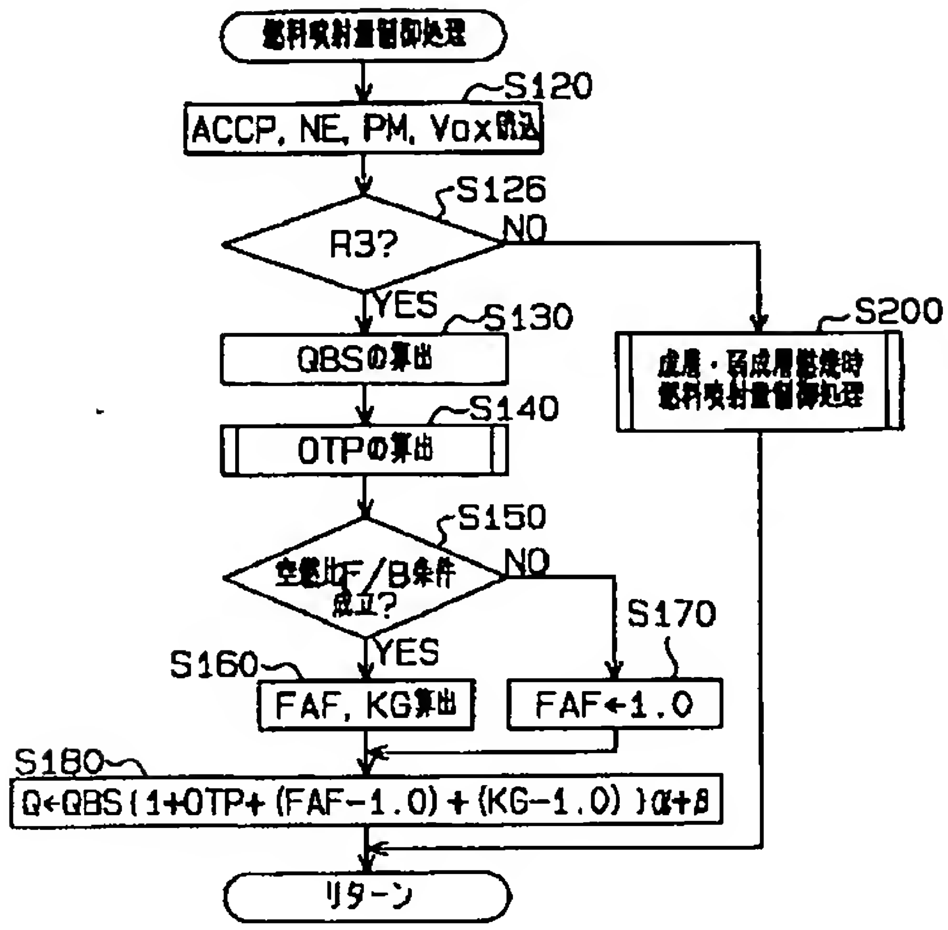
[Drawing 8]



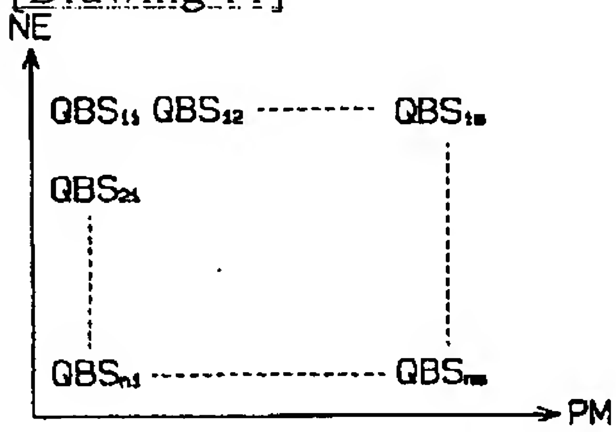
[Drawing 9]



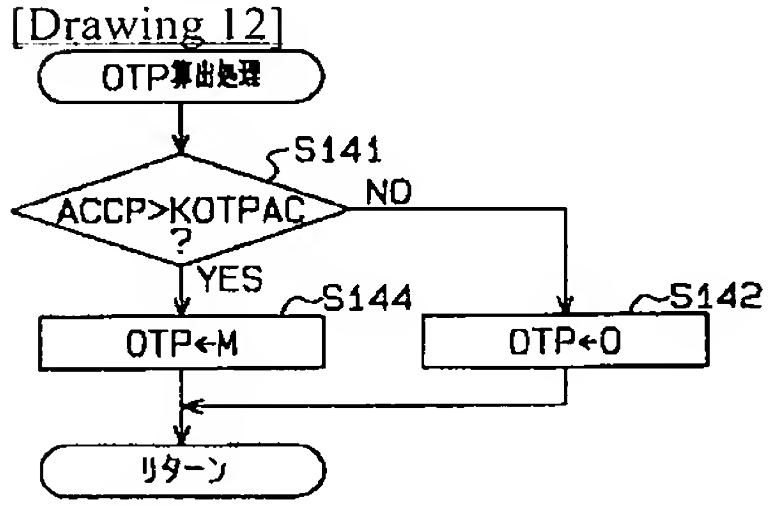
[Drawing 10]



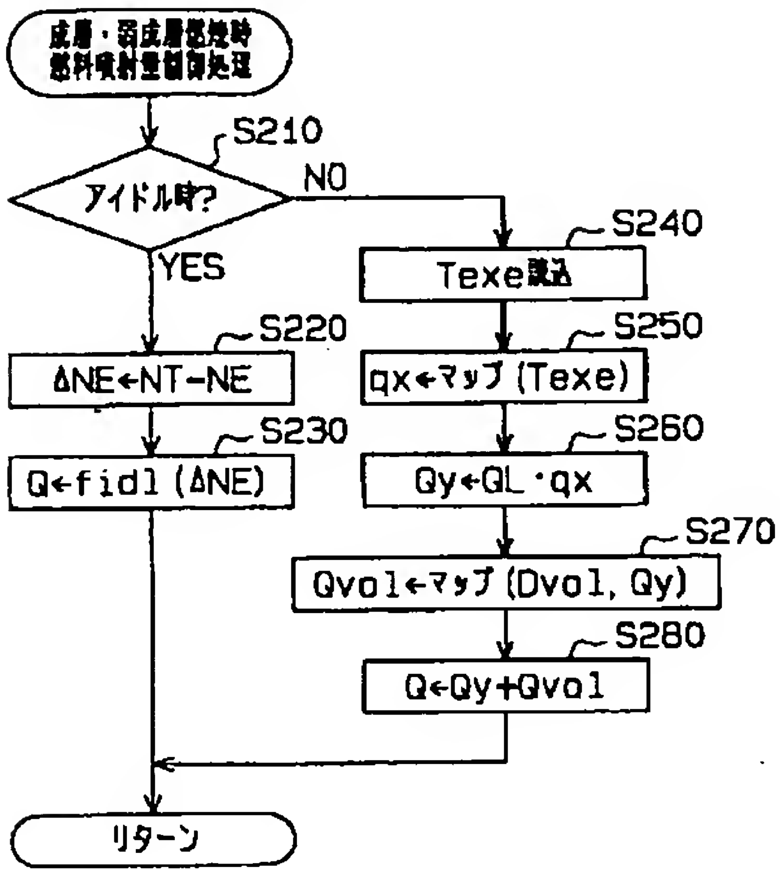
[Drawing 11]



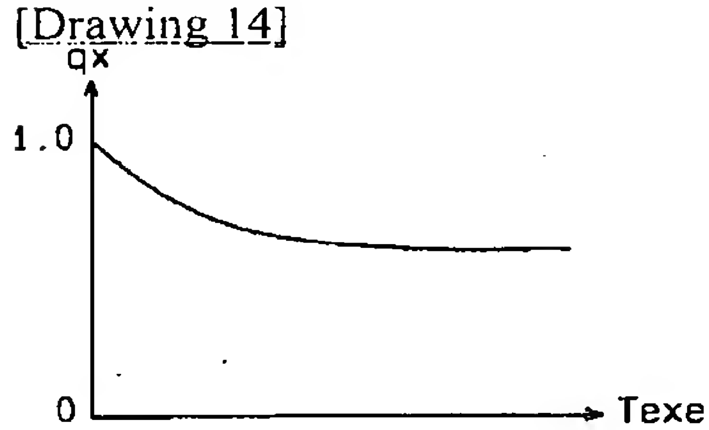
[Drawing 12]



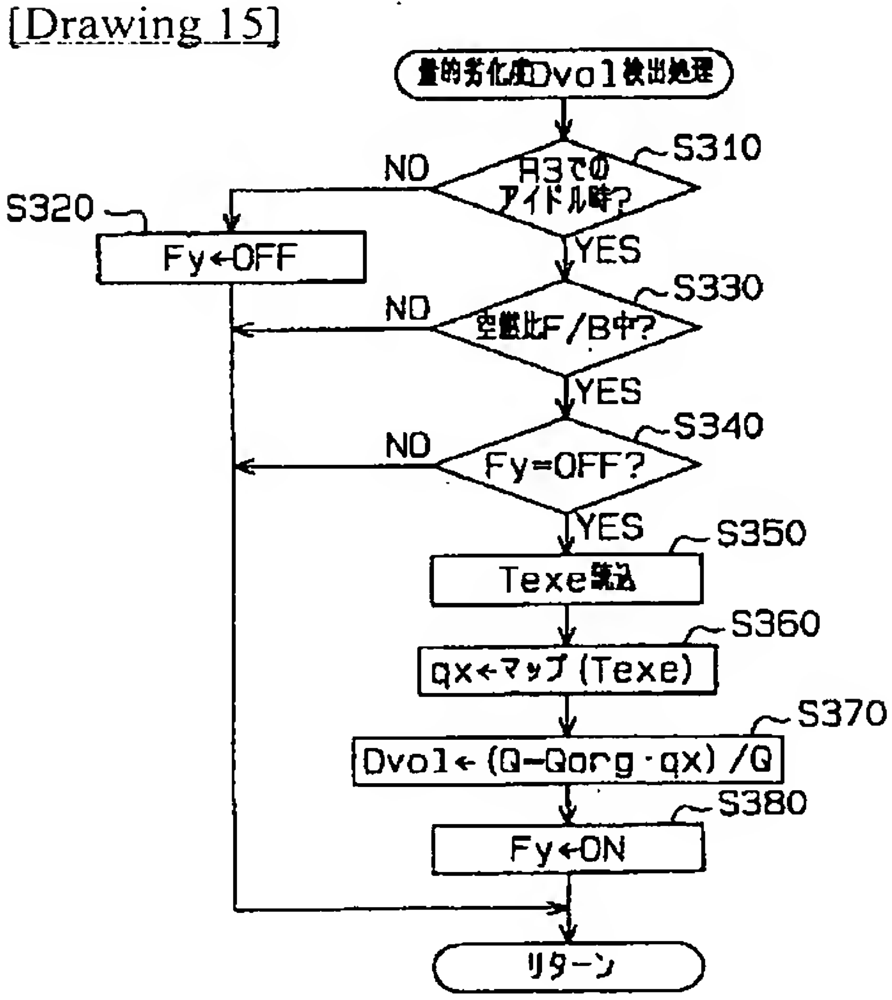
[Drawing 13]



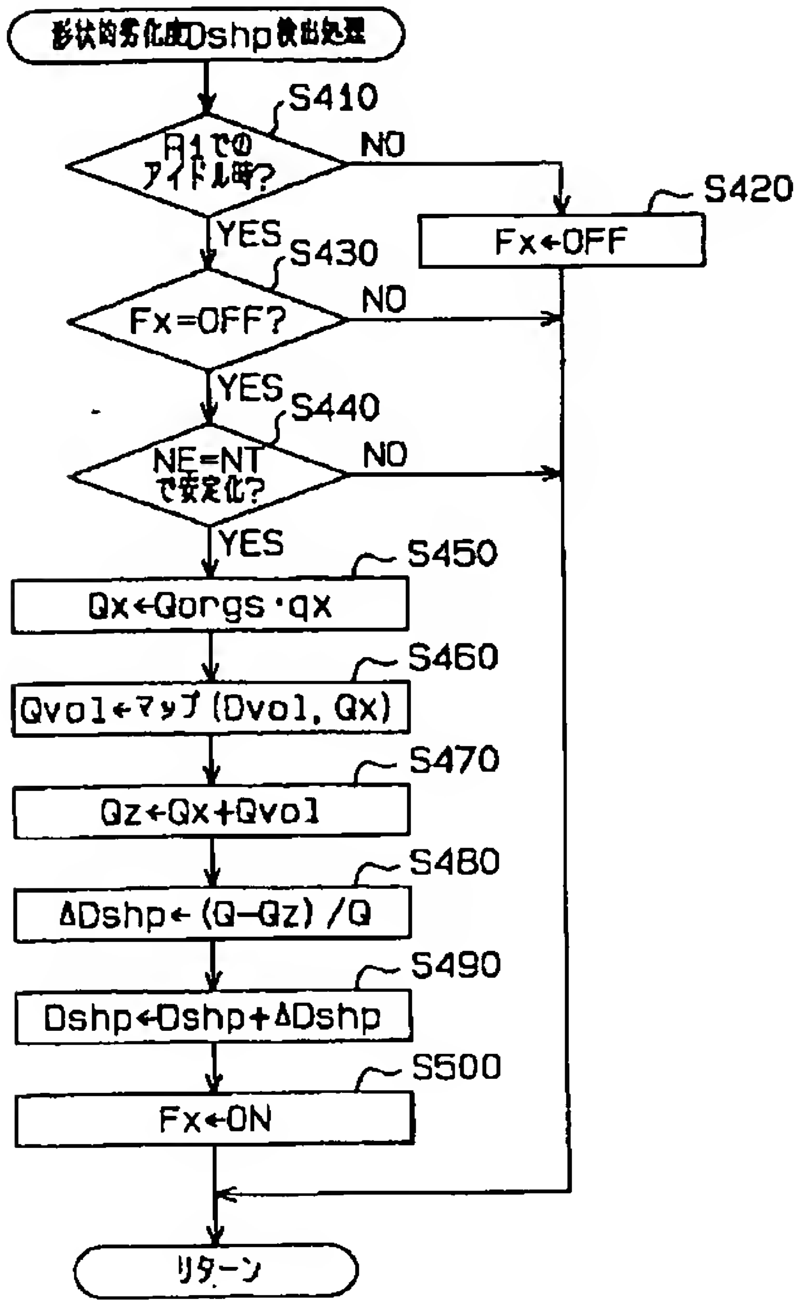
[Drawing 14]



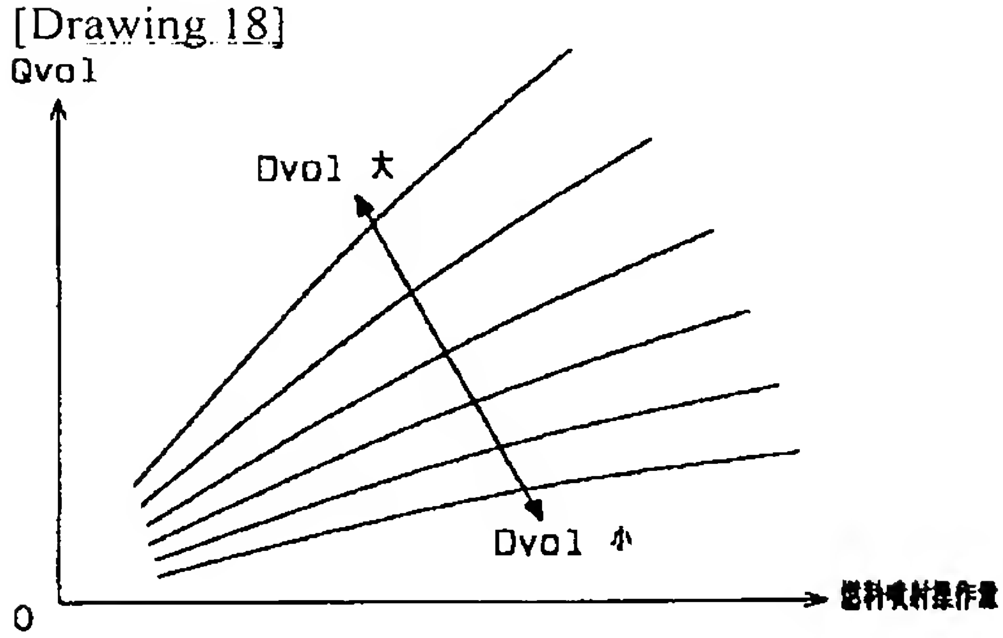
[Drawing 15]



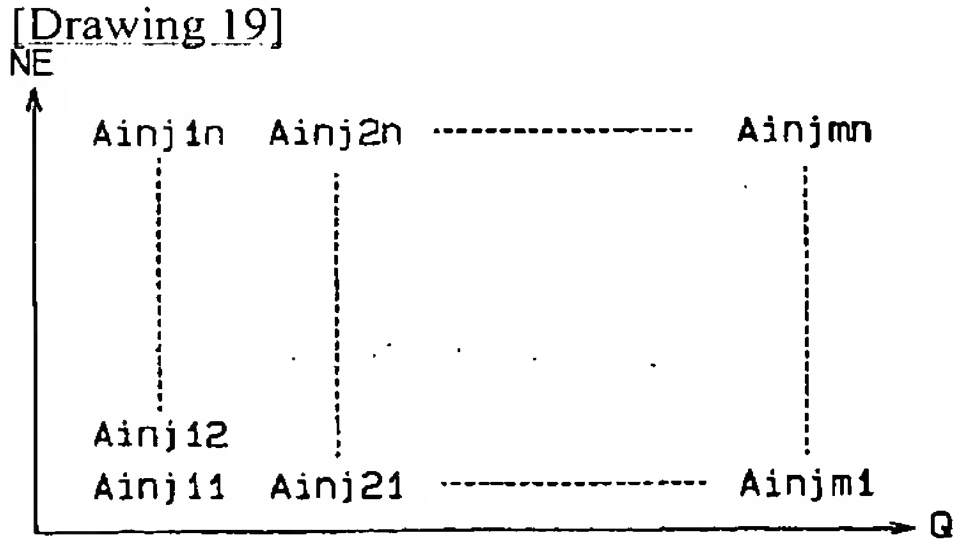
[Drawing 16]



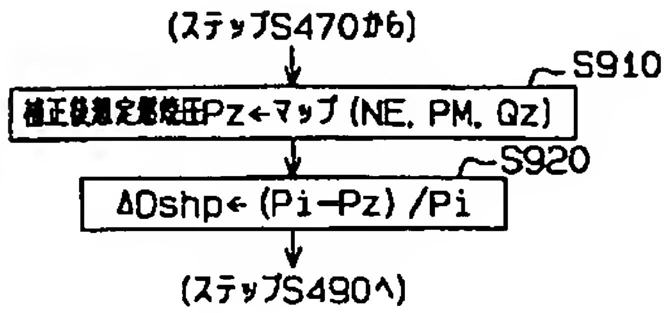
[Drawing 18]



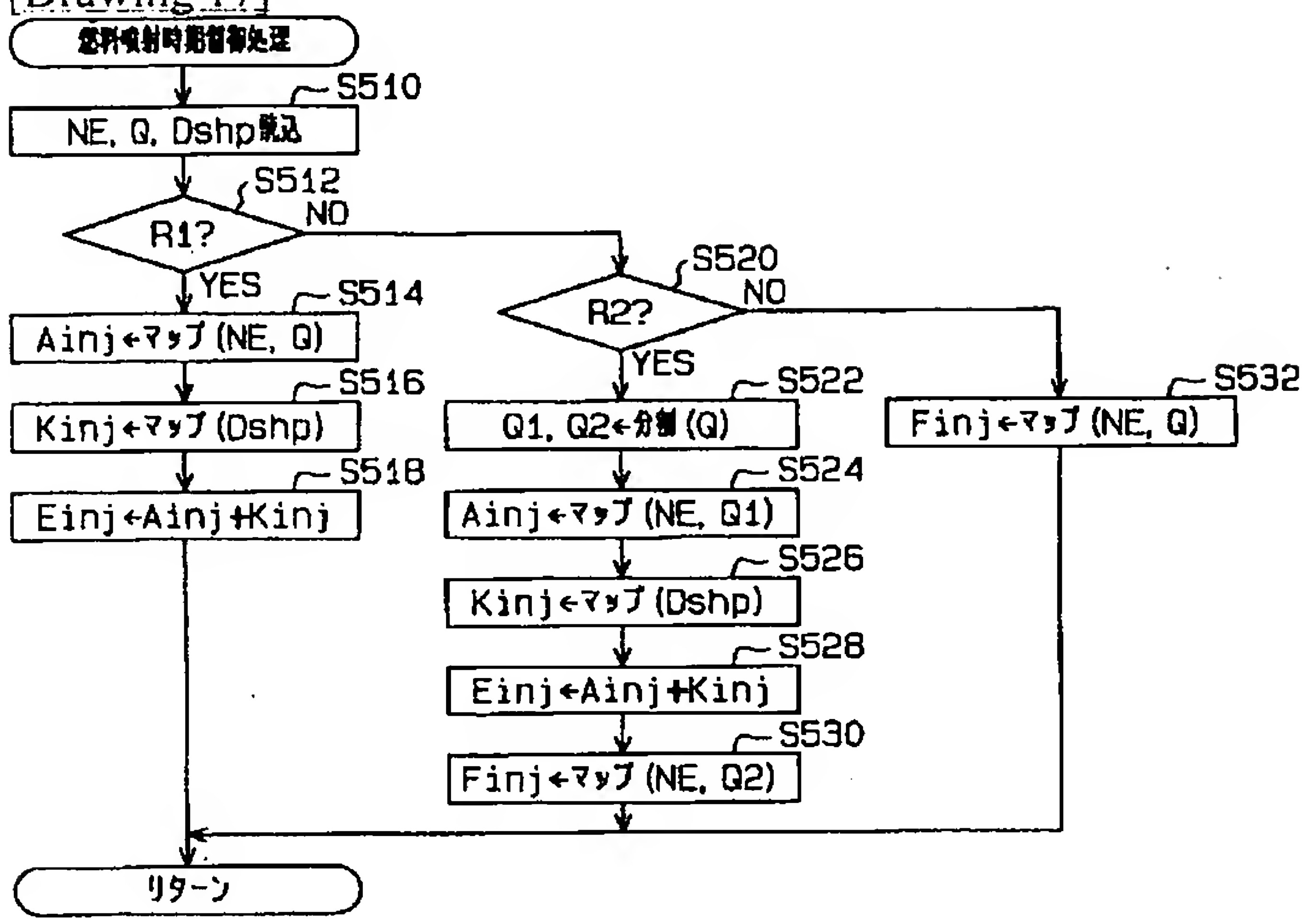
[Drawing 19]



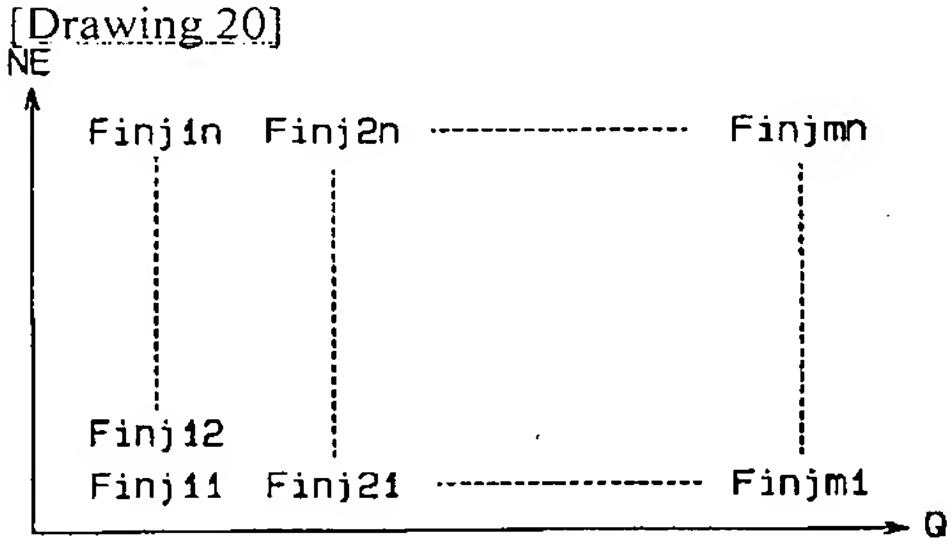
[Drawing 29]



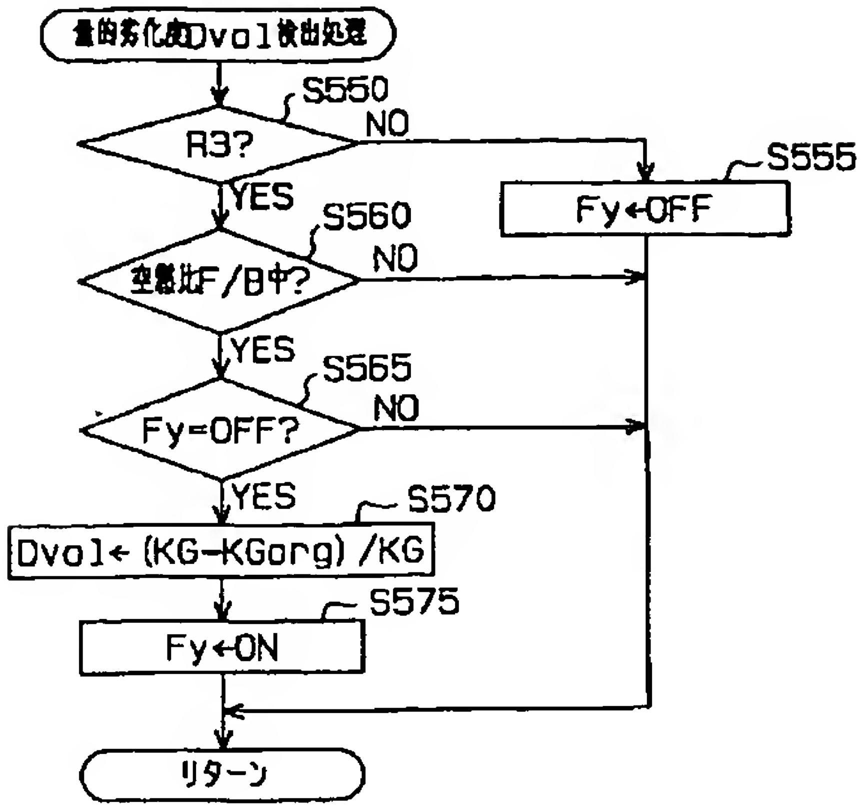
[Drawing 17]



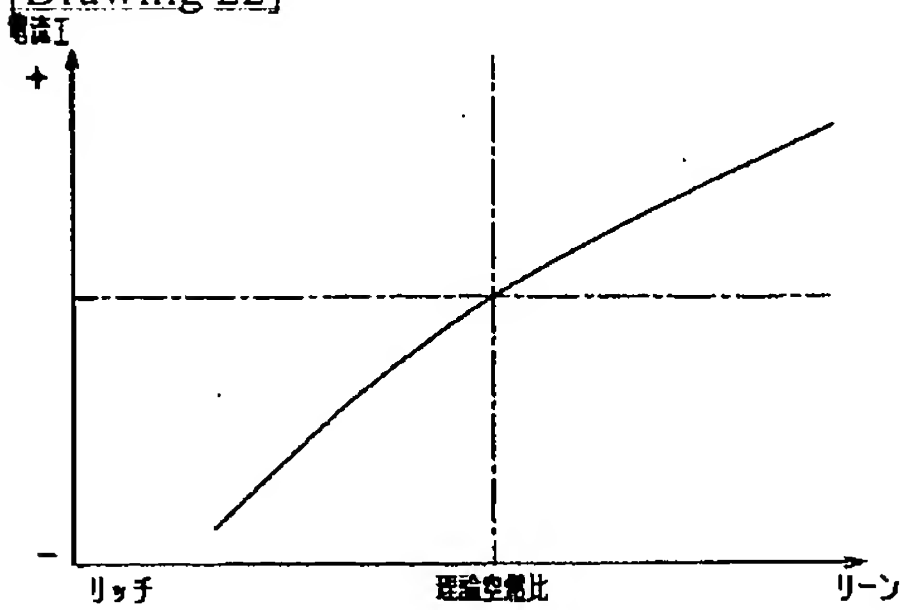
[Drawing 20]



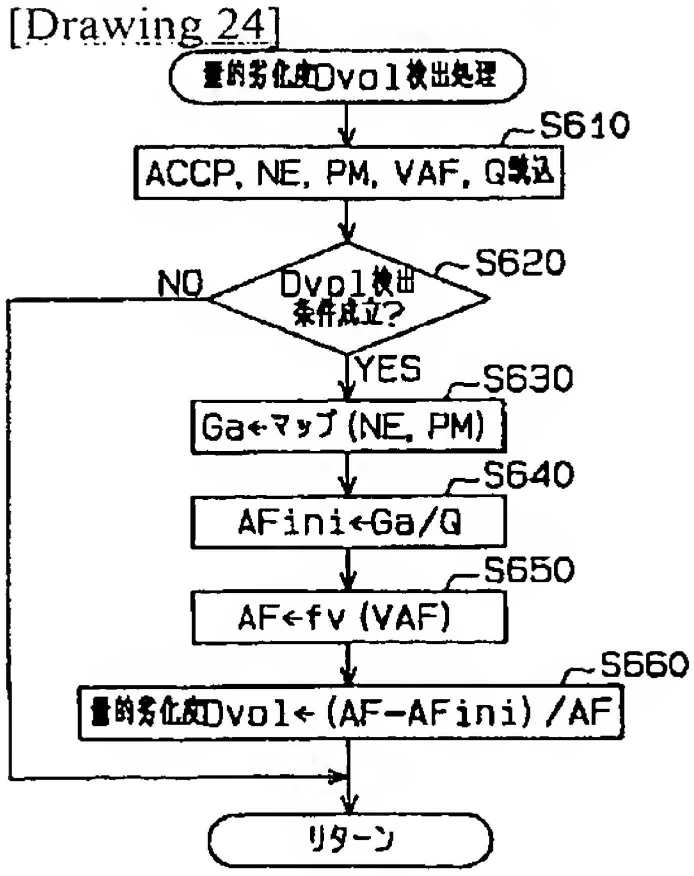
[Drawing 21]



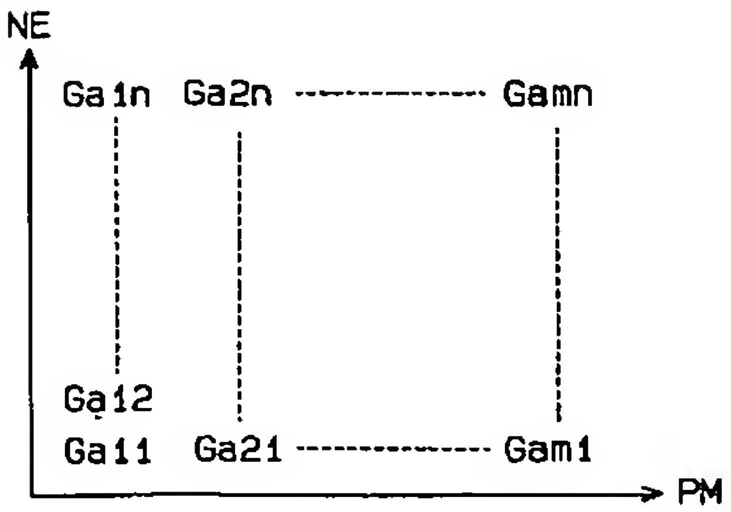
[Drawing 22]



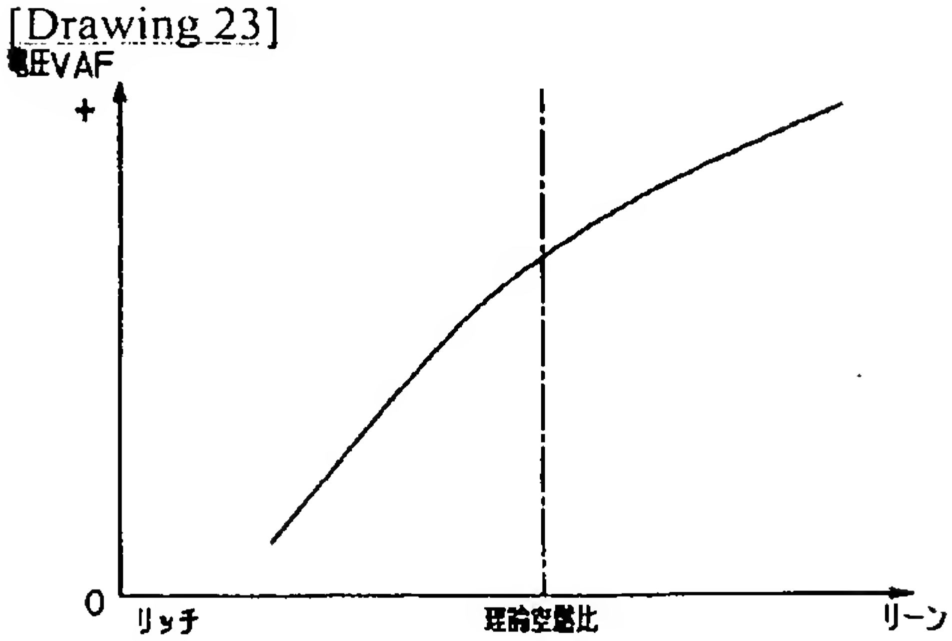
[Drawing 24]



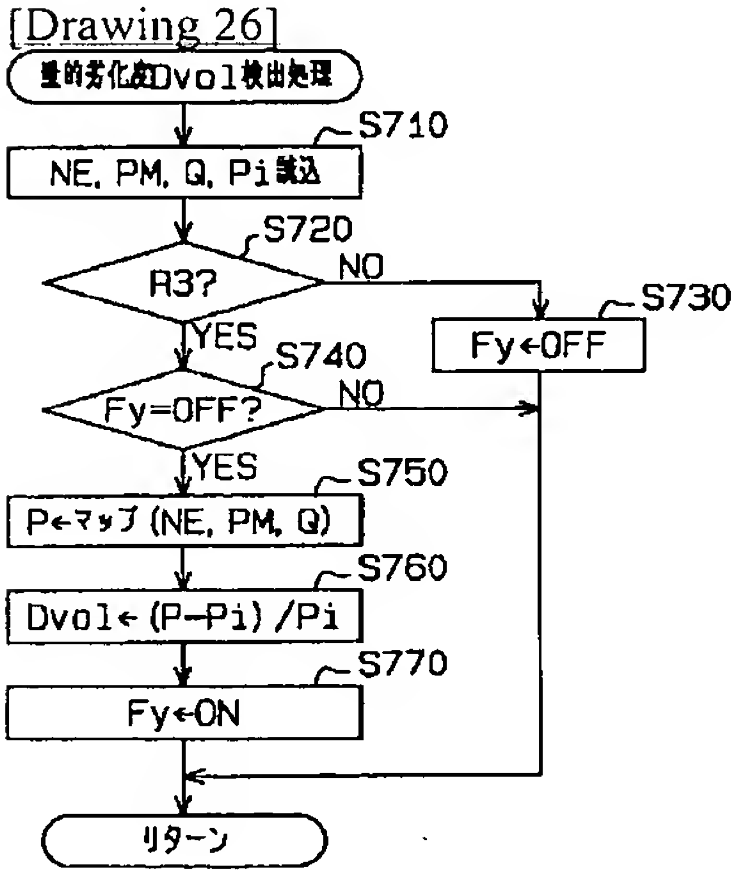
[Drawing 25]



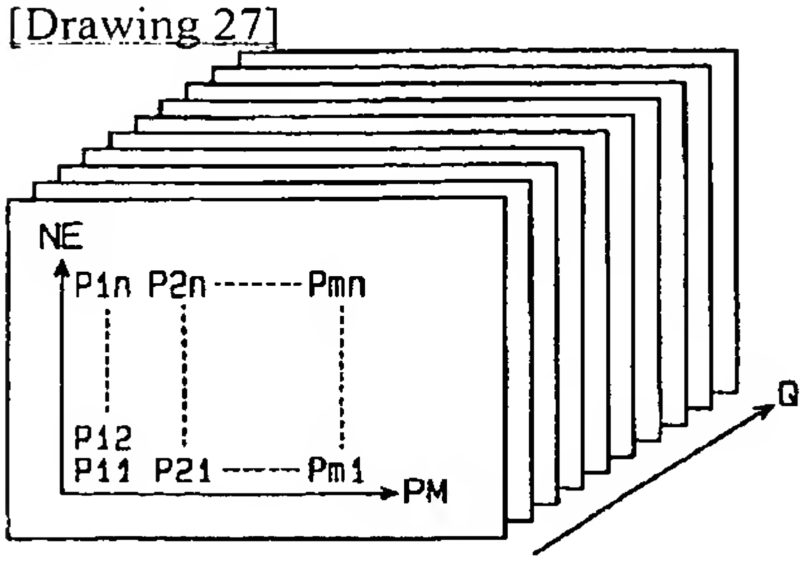
[Drawing 23]



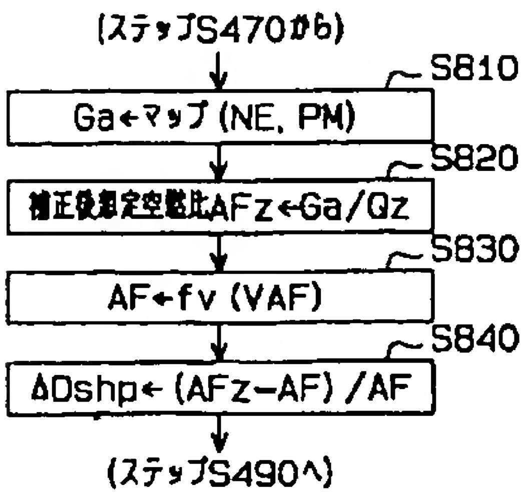
[Drawing 26]



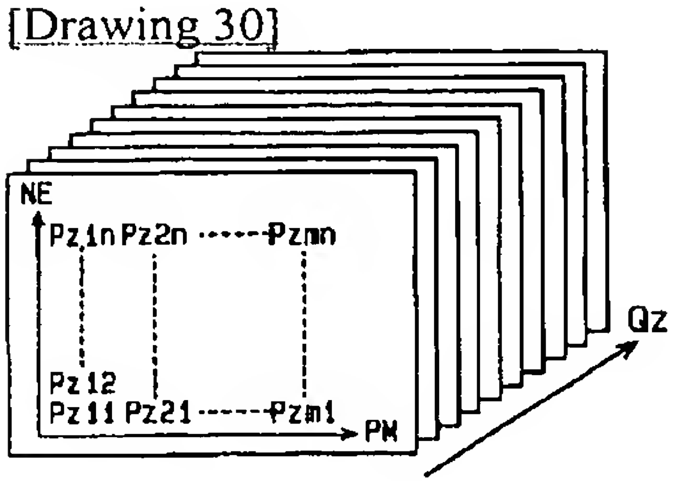
[Drawing 27]



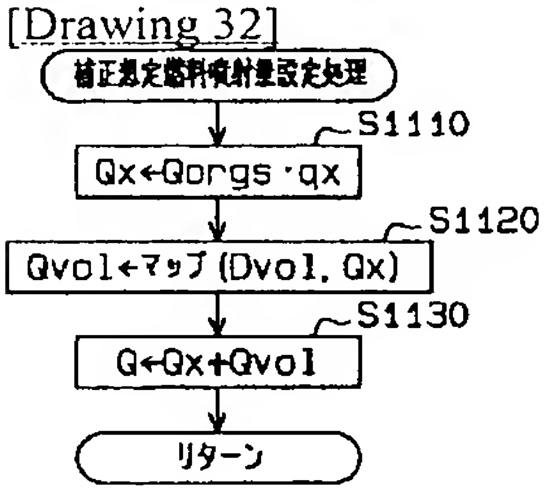
[Drawing 28]



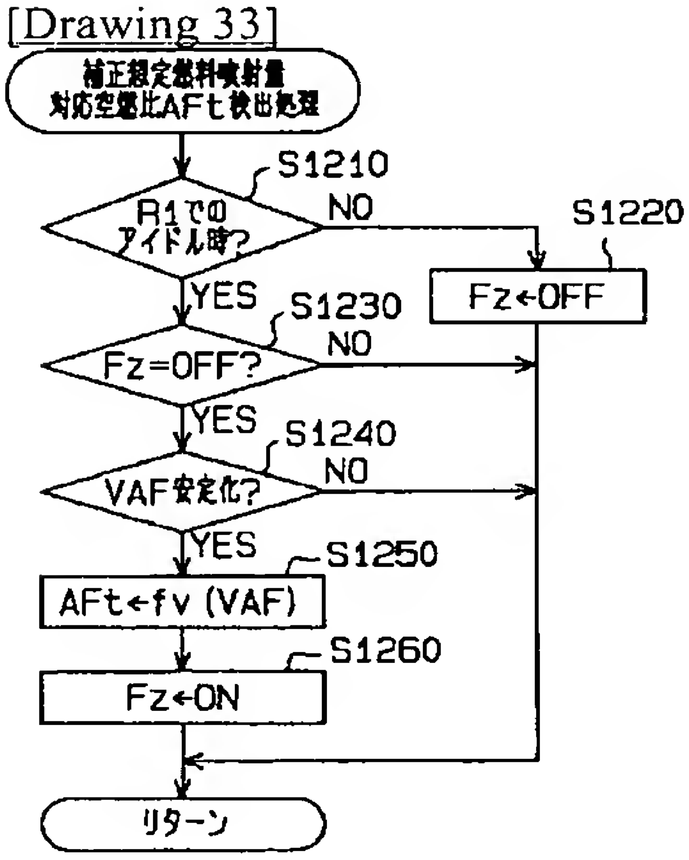
[Drawing 30]



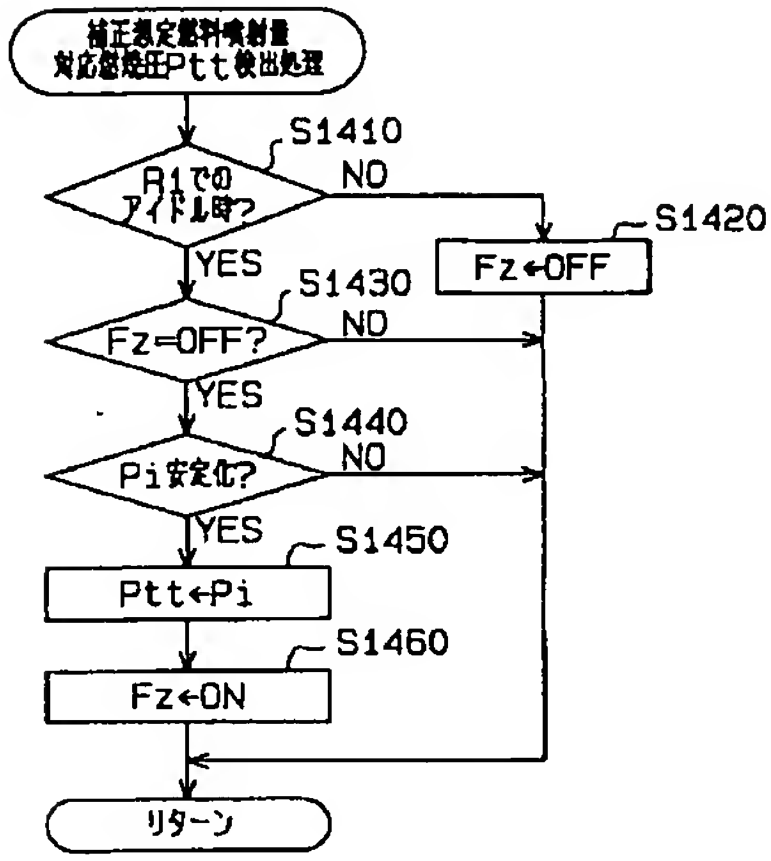
[Drawing 32]



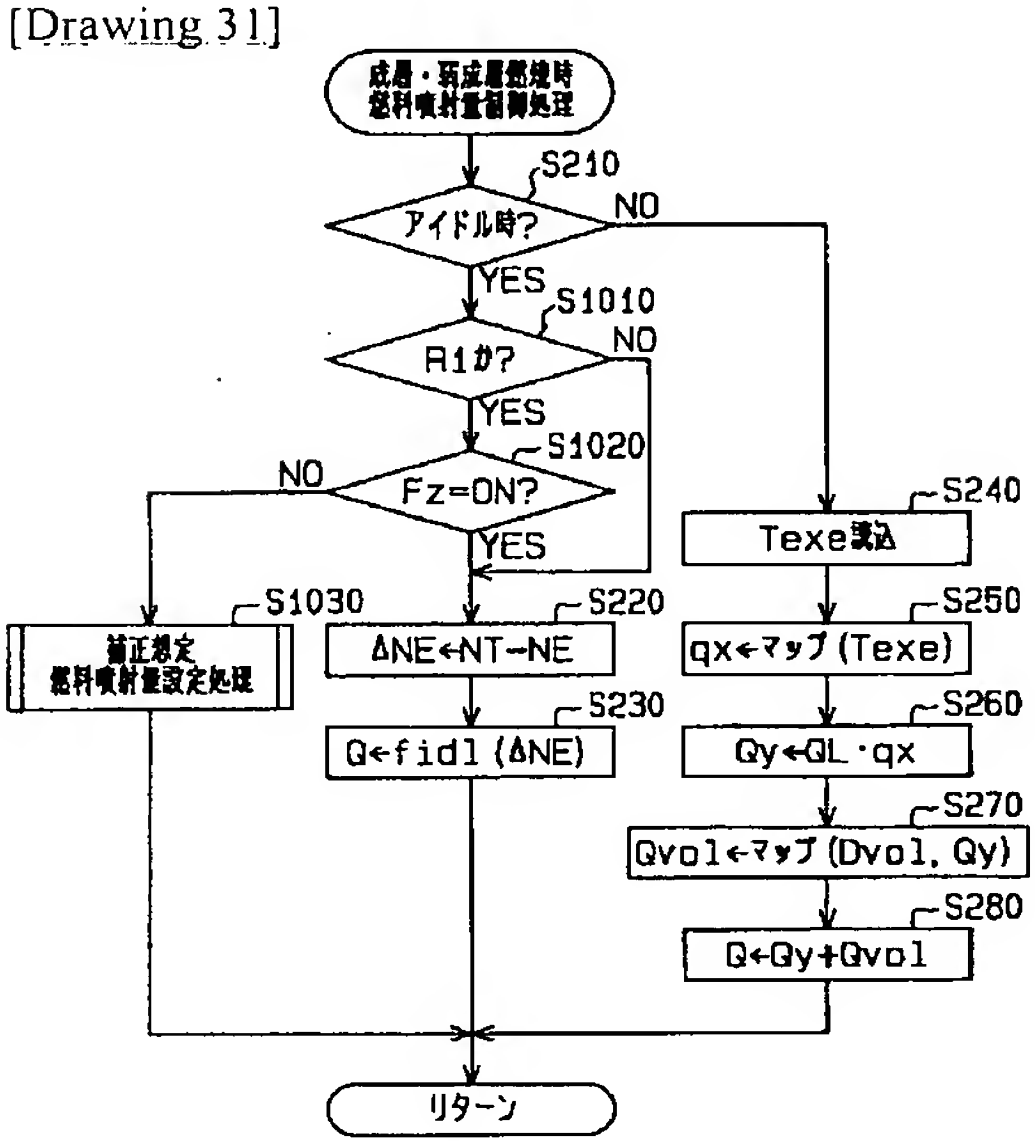
[Drawing 33]



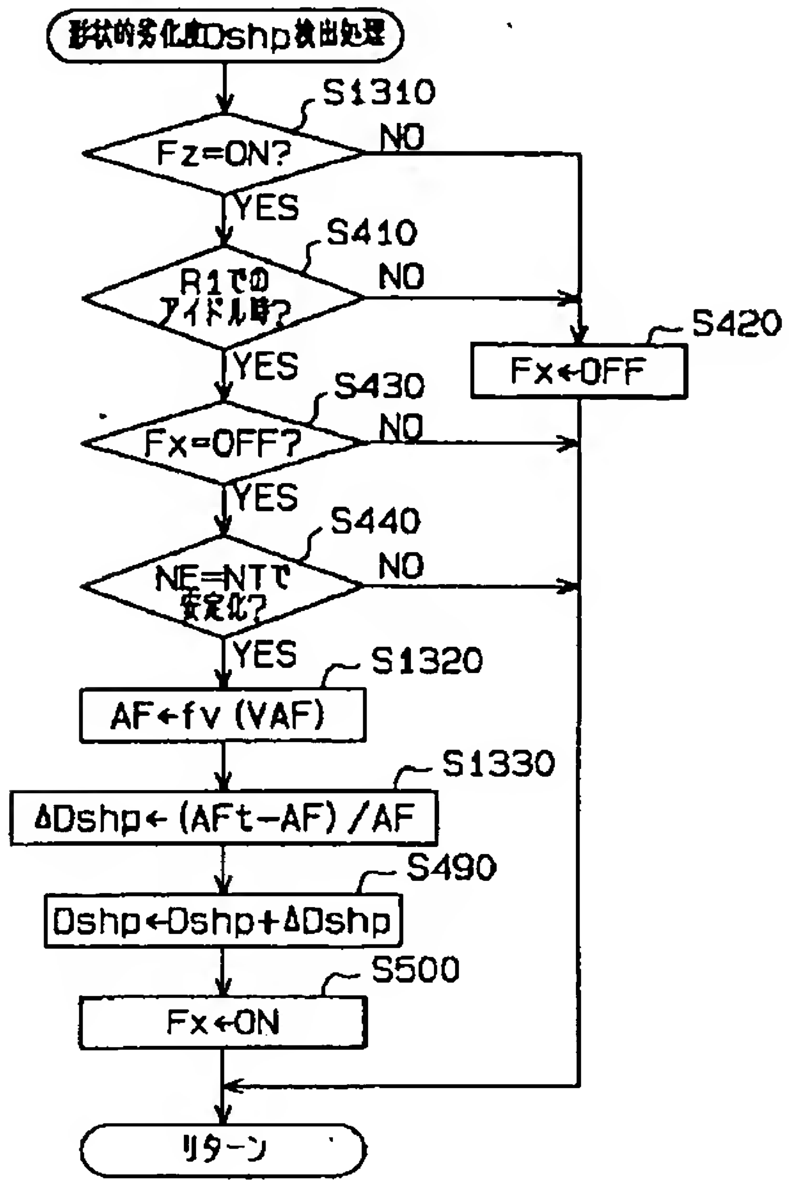
[Drawing 35]



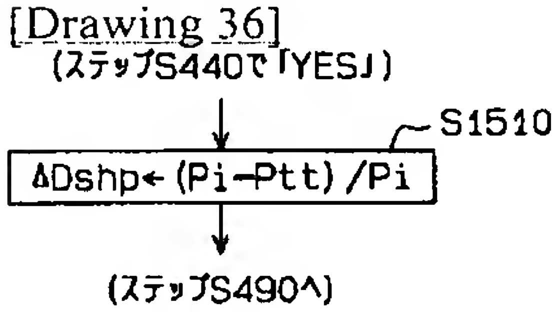
[Drawing 31]



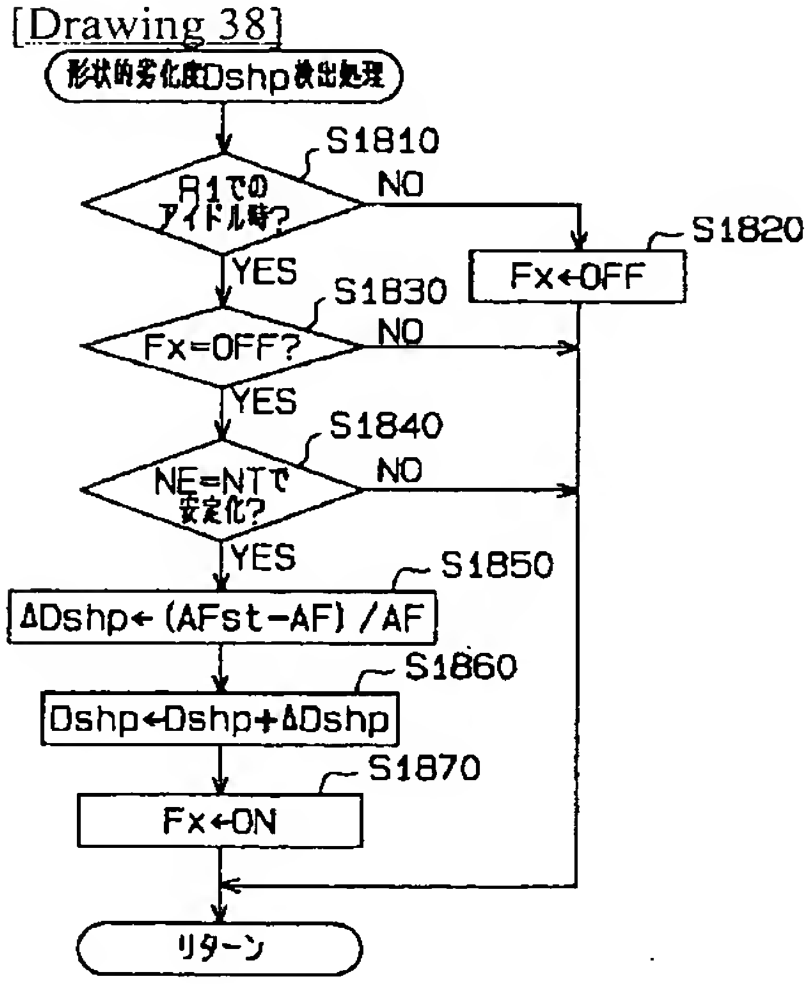
[Drawing 34]



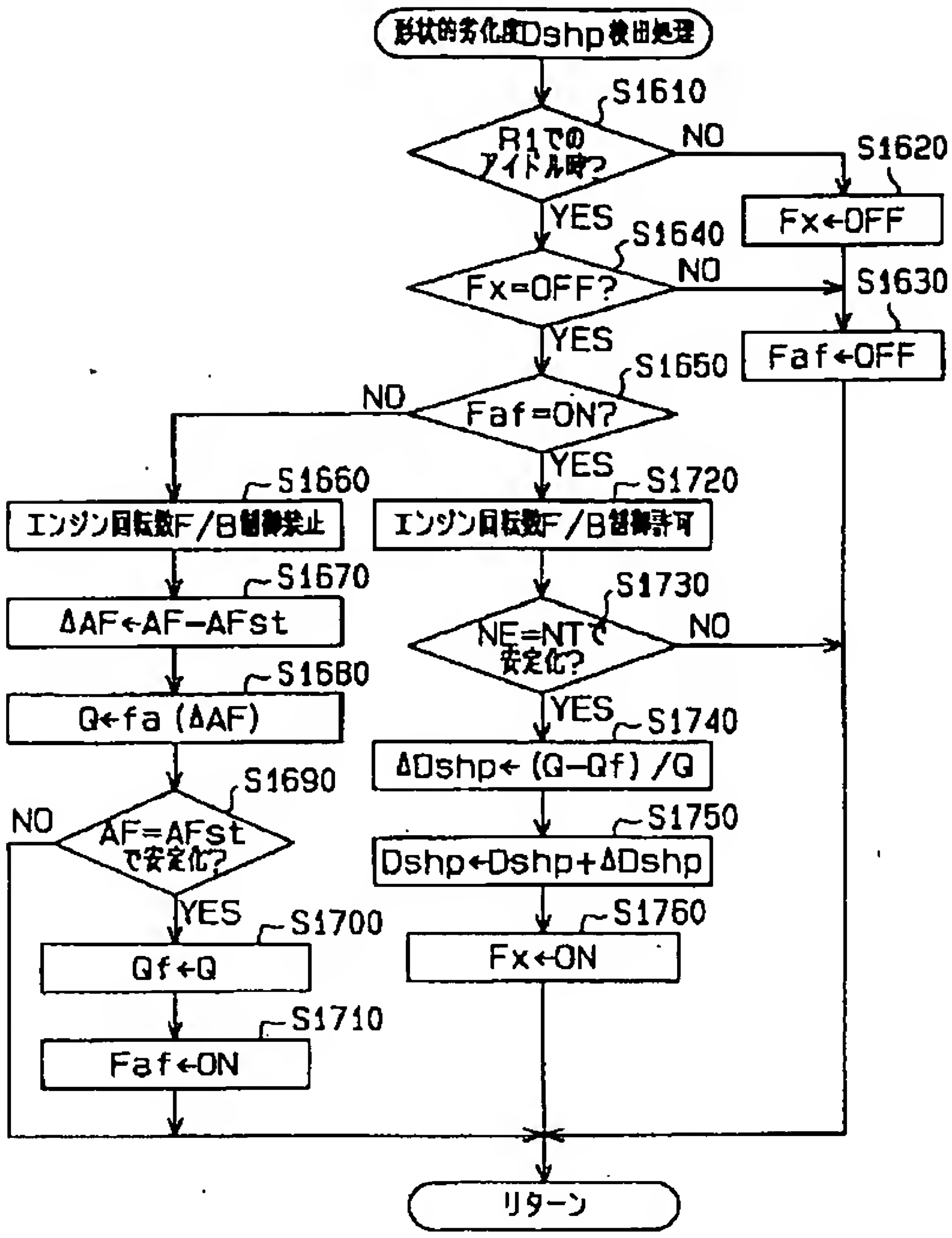
[Drawing 36]



[Drawing 38]



[Drawing 37]



[Translation done.]